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**BMP  
Retrofit  
PILOT PROGRAM**

**COMPOSITE SITING STUDY  
DISTRICT 11**

*Prepared For:*

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## **1.0 Executive Summary**

This report presents a proposal for the Retrofit Pilot Program in Caltrans District 11 in response to the agreement reached as a part of the District 11 Consent Decree. The report also includes a composite of seven siting studies submitted to Caltrans and the Plaintiffs by Robert Bein, William Frost & Associates (RBF) between December 9, 1997 and January 7, 1998. These individual documents have been revised to reflect review comments from the Plaintiffs as well as information obtained during the final elements of the site selection process. The individual studies address the siting of pilot Best Management Practices (BMPs) for stormwater discharges from Caltrans facilities within the urbanized area of District 11. These individual reports are presented as chapters in this Retrofit Pilot Program proposal.

### **1.1 BMP Retrofit Pilot Proposal**

#### ***1.1.1 Background***

As part of the Caltrans District 11 Retrofit Pilot Program, five projects comprised of multiple BMPs are to be sited in the urbanized area of San Diego County. The types of BMPs proposed pilot projects within the District include biofiltration strips, biofiltration swales, infiltration basins, infiltration trenches, media filters, an extended-detention basins, and a wet basin. The total construction cost for all pilot projects within District 11 is required to total at least \$2.5 million.

The retrofit pilot projects have been sited to permit observations pertaining to technical feasibility, costs of retrofitting and benefits of various BMPs. Each site has been selected while keeping in mind its appropriateness to the type of best management practice to be evaluated, and without pre-judgment about the outcome of the associated retrofit pilot study.

Specific criteria outlined in the Consent Decree and used in siting of the Retrofit Pilot Projects include:

1. Hydraulic proximity to sensitive receiving waters;
2. Potential for improvements in water quality, including without limitation water quantity effects;
3. Technical feasibility;
4. Integration with other scheduled activities; and
5. Cost reasonableness.

Hydraulic proximity refers to the distance between the BMP site and the receiving water but also the directness of the hydraulic connection. For example, in the case where the paths are unimpeded from the storm drain to the outfall and then to the receiving water, the hydraulic connection is considered to be close.

Potential improvements to water quantity was addressed in a separate paper study, completed by RBF. Water quantity mitigation for each the BMP sites was studied and determined to be infeasible for this Pilot Retrofit Program. Full discussion is provided in the text of this study, found in Appendix G.

Potential for improvement in water quality was considered by identifying impaired and sensitive receiving waters. To determine water bodies that were most impaired, the Regional Water Quality Control Board was contacted. Many of the water bodies selected are 303d listed waters by the USEPA, as not achieving their designated beneficial uses. Sensitive types of receiving waters were determined to be lagoon environments where waters moved at low velocities, leading to poor mixing in the water column. In addition, salt water environments, like lagoons, are more susceptible to potential toxic metal impacts than fresh water environments.

Sites have been considered along Caltrans freeways and highways, maintenance stations and park and ride lots within the urbanized San Diego County area of District 11. Primary emphasis has been given to sites within a target watershed as defined in Section 1.3 of this chapter. Secondary emphasis has been given to sites within a defined priority alternative watershed also as discussed in Section 1.3 of this chapter. All selected bmp sites can be seen on maps in Exhibits A, and B at the end of this chapter.

### ***1.1.2 BMP Retrofit Pilot Program Proposal***

Caltrans will undertake five retrofit pilot projects in District 11, comprised of seven types of proposed BMPs. Caltrans will develop and implement a coordinated pilot program to test the feasibility and effectiveness of designing, constructing, maintaining and operating the selected BMPs. The five proposed retrofit projects, proposed site locations and estimated construction costs are summarized in Table 1-1. Table 1-1 reflects some changes to the original Retrofit Pilot Program Proposal (October 23, 1997) which resulted from the field investigation of Caltrans facilities in District 11. The proposed changes are described below. The original proposal dated October 23, 1997, can be found in Appendix F.

### ***General Project Criteria***

For each project defined in Table 1-1, Caltrans will design, construct, maintain and monitor the BMP system. The objectives of the program will be as follows:

1. Determine the feasibility of design, construction and maintenance of the selected BMPs;
2. Evaluate the performance of the selected BMPs in removing constituents of concern in highway stormwater runoff; and

3. Evaluate the frequency and magnitude of operational problems associated with maintenance of the structures and maintenance and safety concerns specific to transportation facilities.

Most information on the design requirements and pollutant removal capabilities for each of the BMPs was obtained from two reference manuals. These manuals are:

*Evaluation and Management of Highway Runoff Water Quality*, Federal Highway Administration, U.S. Department of Transportation, Publication No. FHWA-PD-96-032, June 1996; and

*Current Regulatory Best Management Practices for Urban Runoff*, Bruce Phillips, Senior Director of Water Resources Engineering, Robert Bein, William Frost and Associates, Irvine, California, 1998.

Complete records of design, construction, operation, maintenance and monitoring will be kept as a part of the pilot study program for use in the development of a final report as to the feasibility, performance and operational characteristics of the defined projects.



**Table 1-1**

<b>Project</b>	<b>Description</b>	<b>Target or Secondary Watershed</b>	<b>Location</b>	<b>Construction Cost</b>	
<b>1</b>	<b>Extended Detention Basins and Biofilter</b>				
	Site 1: Extended Detention Basin	primary	Interstate 15 and Highway 78 Interchange	\$	282,000
	Site 2: Extended Detention Basin	primary	Northbound Interstate 5 and Manchester Avenue	\$	282,000
	Site 3: Biofiltration Swale	primary	Southbound Interstate 5 at Palomar Airport Road	\$	75,000
			<b>Project 1 Subtotal</b>	<b>\$</b>	<b>639,000</b>
<b>2</b>	<b>Infiltration Trench and Biofilters</b>				
	Site 1: Infiltration Trench	primary	Carlsbad Maintenance Station	\$	50,000
	Site 1: Biofiltration Strip	primary	Carlsbad Maintenance Station	\$	105,000
	Site 2: Biofiltration Swale	primary	Highway 78 Eastbound at Melrose Place	\$	75,000
			<b>Project 2 Subtotal</b>	<b>\$</b>	<b>230,000</b>
<b>3</b>	<b>Extended Detention/Infiltration Basins</b>				
	Site 1: Extended Detention Basin	secondary	Interstate 5 and Highway 56	\$	282,000
	Site 2: Infiltration Basin	primary	Interstate 5 Southbound and La Costa Blvd.	\$	355,000
			<b>Project 3 Subtotal</b>	<b>\$</b>	<b>637,000</b>
<b>4</b>	<b>Wet Basin</b>				
	Site 1: Wet Basin	primary	Interstate 5 Southbound at Manchester Avenue	\$	355,000
			<b>Project 4 Subtotal</b>	<b>\$</b>	<b>355,000</b>
<b>5</b>	<b>Media Filters</b>				
	Site 1: Media Sand Filter	primary	Escondido Maintenance Station	\$	150,000
	Site 2: Media Sand Filter	primary	Interstate 5 Southbound at Highway 78 Park/Ride	\$	150,000
	Site 3: Media Sand Filter	primary	Interstate 5 Northbound at La Costa Blvd. Park/Ride	\$	150,000
	Site 4: Compost Filter	secondary	Kearny Mesa Maintenance Station	\$	200,000
			<b>Project 5 Subtotal</b>	<b>\$</b>	<b>650,000</b>
			<b>Construction Total - All Projects</b>	<b>\$</b>	<b>2,511,000</b>

## ***Project Descriptions***

### **Project 1 – Extended Detention Basins and Biofilter**

Project 1 consists of identifying 3 sites along a Caltrans freeway or highway to construct two extended detention basins and one biofiltration swale. The project will consist of determining the feasibility of constructing these types of BMPs within the highway right-of-way and assessing their performance relative to the removal of highway constituents of concern. The extended detention basins will be designed with a detention time of 48 hours for the selected design storm. Larger storm events will exceed the capacity of the basins and discharge through the facility overflow weir. Water quality will be sampled using automated equipment for the extended detention basins inflow and outflow to determine basin efficiency in the removal of highway stormwater runoff constituents. A biofiltration swale will be constructed under prevailing guidelines to accommodate the design storm. Influent and effluent to the biofiltration swale will be monitored for water quality parameters using automated samplers. The project will establish procedures and schedules for maintenance of the swales and basins.

The detention basins are proposed to be located at the intersection of I-15 and SR 7878 and at Manchester Avenue and I-5. The biofilter, a swale, is proposed at I-5 along the southbound travel lanes just north of Palomar Airport Road.

The construction cost for each basin is estimated to be \$282,000. The construction cost for the swale is estimated to be \$75,000. The total construction cost for Project 1 is estimated to be \$639,000.

### **Project 2 – Infiltration Trench and Biofilters**

Project 2 consists of construction of one infiltration trench/biofiltration strip combination and one biofiltration swale. The infiltration trench/biofilter combination is proposed for constructed at a maintenance station while the biofiltration swale is proposed along a freeway. The biofiltration swale and strip will be constructed under prevailing guidelines to accommodate the design storm. Influent and effluent to the biofilters will be monitored for water quality parameters using automated samplers. The infiltration trench will be equipped with monitoring wells to allow computation of infiltration rates, and observations relative to declining infiltration performance. Groundwater will be sampled using a well, or pressure-vacuum lysimeter in the case where the groundwater table is relatively deep. The infiltration trench/biofiltration strip combination will be visually monitored over a two year period using the following criteria:

- Maintenance frequency of the trench to maintain adequate infiltration rate;
- Rate of infiltration under the typical storm condition;
- Problems associated with disposal of material that accumulates in the trench;
- Potential for groundwater contamination and associated regulatory implications;
- General operation and performance of the devices.

The infiltration trench/biofiltration strip combination is proposed at the Carlsbad Maintenance Station. The biofiltration swale is proposed along the eastbound travel lanes of SR 78 at the Melrose Place off-ramp.

The construction cost for Project 2 is estimated to be \$230,000. The cost breakdown is \$50,000 for the infiltration trench, \$105,000 for the biofiltration strip, and \$75,000 for the biofiltration swale.

### **Project 3 – Extended Detention and Infiltration Basins**

Two basins are proposed to be constructed at locations along an existing freeway or highway serving a Caltrans storm drain outfall. The project will consist of constructing one extended detention basin, and one infiltration basin to determine the feasibility of constructing these types of BMPs within the highway right-of-way, and to assess their performance relative to the removal of highway constituents of concern. The extended detention basin will be designed with a detention time of 48 hours for the selected design storm. The infiltration basin will be designed to capture and infiltrate the selected design storm. Larger storm events will exceed the capacity of the basins and discharge through the facility overflow weir. Water quality will be sampled using automated equipment for the extended detention basin inflow and outflow to determine basin efficiency in the removal of highway stormwater runoff constituents. The basins will be monitored over a two year period using the following criteria:

- Maintenance frequency of the infiltration basin to maintain adequate infiltration rate;
- Rate of infiltration under the typical storm condition;
- Problems associated with disposal of material that accumulates in the trench;
- Potential for groundwater contamination and associated regulatory implications; and
- General operation and performance of the devices.

In addition, groundwater will be sampled below the infiltration basin site using a well, or pressure-vacuum lysimeter where the groundwater table is relatively deep. Rate of percolation of the infiltration basin will be monitored, and testing of the basin sediments will be performed at the end of the established monitoring period.

The extended detention basin is proposed at the I-5 and SR 56 interchange, and the infiltration basin is proposed along the southbound lanes of I-5 north of La Costa Blvd.

Component construction cost for Project 3 is estimated to be \$282,000 for the extended detention basin and \$355,000 for the infiltration basin, for a total Project 3 construction cost of \$637,000.

#### **Project 4 – Wet Basin**

Project 4 will consist of the construction of a wet basin serving a Caltrans freeway or highway. The pool volume shall be equal to the runoff volume from the design storm, plus additional volume above the permanent pool to provide a 24 hour drain time for the design storm event. Emergent vegetation will be planted around the basin periphery to enhance constituent removal and improve aesthetics. A perennial water source will be a key component of the siting of this BMP. Possible water sources include locations where there is groundwater infiltration to the Caltrans storm drain system, or where the pond may be excavated to intersect the groundwater table. It will be important to sample this 'source' water to document the constituents it contains. It is anticipated that such baseline sampling can be completed early in the process.

Monitoring of the basin stormwater influent and effluent will be accomplished using automatic samplers, flow rate will be monitored and basin sediments will be sampled at the termination of the monitoring period.

The wet basin is proposed along the southbound lanes of the I-5 at Manchester Avenue. The construction cost for the wet basin is estimated to be \$355,000.

#### **Project 5 – Media Filters**

Project 5 consists of identifying four sites for the installation of media filters. The media filters will be constructed at Caltrans maintenance facilities and park and ride lots where maintenance related activities occur and where vehicles are parked for long periods of time.

Four sites are proposed for the installation of sand or compost filters. The filters will be constructed at two maintenance stations and two park and ride lots. The media filters will be designed using established procedures and manufacturer's recommendations. Water quality monitoring will be performed following construction to determine the performance of the filter in removing constituents in highway runoff. Inflow and outflow will be monitored using automatic sampling equipment. The filters will also be monitored relative to maintenance requirements, with specific attention given to the frequency of maintenance required to sustain the effectiveness of the filter.

The sand media filters are proposed at the Escondido Maintenance Station, I-5 and La Costa Avenue Park and Ride, and I-5 and Highway 78 Park and Ride. A compost media filter is proposed at the Kearny Mesa Maintenance Station.

The construction cost for the sand media filters is estimated to be \$150,000. The cost for the compost filter is estimated to be \$200,000. The total construction cost of Project 5 is estimated to be \$650,000.

### ***Project Outline***

The general steps in the implementation of the District 11 Retrofit Pilot Program are shown in the following outline. More detailed schedule information, including key decision points, can be seen in the “Scoping Study, Retrofit Pilot Program, District 11”.

#### **Project Site Selection**

- A. Preliminary Site Selection
  - 1. Identify Candidate Sites
  - 2. Refine to Preliminary Sites
  - 3. Develop Preliminary Site Reports
  - 4. CT/EPA/NRDC SD Baykeeper Review/Field Review/Approval
- B. Final Site Selection

#### **2. Project Design**

- A. Site Survey
- B. Site Topography Compilation
- C. Plan Preparation
- D. Plan Check
- E. Plan Revisions
- F. Plans Signed/Released for Bidding
- G. Plaintiff Review

#### **3. Bid Projects**

- A. Advertise
- B. Award
- C. Construction Begins

#### **4. Construction**

- A. Project 1
- B. Project 2
- C. Project 3
- D. Project 4
- E. Project 5

#### **5. Monitoring**

- A. Visual Monitoring
- B. Stormwater Quality Monitoring

#### **6. Report**

- A. Write Final Report
- B. Review by CT/EPA/NRDC/SD Bay Keeper
- C. Revisions
- D. Final Report

### ***Proposed Changes to BMP Retrofit Pilot Program***

Changes to the original Retrofit Pilot Program Proposal (October 23, 1997) have resulted from the field investigations that have been carried out subsequent to the original proposal development. Specifically, two investigations, stormwater runoff sampling and infiltration testing have altered the composition of the proposed program.

A stormwater runoff sampling program was completed at the Escondido Maintenance Station to determine the viability of constructing a coalescing plate-type oil/water separator device. Four storms were sampled in November and December of 1997. The data is contained in the Oil/Water Separator siting chapter of this report. The results of the sampling program indicated that the concentration of total oil and grease in the runoff water is, on average, at or below the concentration that may be obtained in the effluent of a coalescing plate type separator. Consequently, it was determined that installation of a separator at this location would not be viable. Instead, installation of a sand media filter is proposed at this site.

The second field investigation that has changed the structure of the proposal is the geotechnical investigation for the infiltration BMP sites. Percolation tests, which are described in detail in the chapters pertaining to the infiltration basins and trenches were performed at candidate sites within the District. The original proposal called for the construction of three infiltration basins and two infiltration trenches. After testing at multiple sites within the target and secondary watershed, only one viable infiltration basin site and one viable trench site was identified. In order to compensate for the elimination of an infiltration trench project and two infiltration basin projects, construction of two additional extended detention basins and a compost media filter is proposed.

The siting studies are provided in Chapters 2 through 8 of this report. Site notes and geotechnical information are contained in Appendices. Exhibit A indicates the locations of the proposed pilot projects within the target watershed. Exhibit B indicates the locations of the proposed pilot projects in the secondary watershed. The exhibits also indicate the boundaries of the target hydrologic units as defined in the Region 9 Water Quality Control Plan.

### **1.2 General Siting Approach**

Site selection has involved a multi-disciplinary approach to finding and evaluating potential sites for locating pilot projects to evaluate the various best management practices included in the Retrofit Pilot Program. After preliminary reconnaissance, siting was focused initially on the potentially more difficult pilot projects to locate. The first potential pilot projects to be sited were the oil/water separator projects which required monitoring of oil and grease in stormwater runoff before a final decision on whether or not to construct and operate such pilot projects could be made. Infiltration BMPs

required a more intensive geotechnical screening investigation following site selection using space, drainage patterns and land use criteria.

After initial selection of candidate sites, RBF conducted site reviews with representatives of Caltrans, NRDC, Baykeeper and the USEPA and received comments from them concerning the recommended sites. As the site selection process evolved, siting recommendations were refined to insure consistency with the original intent of the Stipulation.

### ***1.2.1 Siting Process***

Sites were selected using a weighted decision matrix process. Criteria significant in the selection of the retrofit project were assembled and then assigned a weighting factor to emphasize the more important selection criteria as compared to less critical selection criteria. All candidate sites were reviewed and ranked according to the weighted criteria established for the subject BMP. This criteria is defined and discussed in detail in Appendix C. Some of the primary criteria used in site selection (in no particular order) were:

- Maintenance Access
- Presence of Vehicles and Heavy Equipment
- Space Availability
- Proximity to structures
- Drainage pattern

The 'best' sites were selected as those accumulating the highest composite score for all criteria established in the decision matrix. In many cases, multiple BMPs were suitable for a proposed site. Sites previously selected for other BMP pilot projects were generally given priority to those selected later in the siting process, consistent with the program methodology of siting the pilot projects with the most stringent criteria first. BMPs that are more difficult to site (such as infiltration devices) were sited earlier in the process as compared to those that had less stringent siting requirements. This method of prioritized siting ensured that the BMP best suited to a particular site was selected.

## **1.3 BMP Site Selection Criteria**

The criteria used to select sites varied depending on the best management practice to be evaluated. However, there have been several general criteria that have controlled the selection of all retrofit pilot project sites. First, the sites must be appropriate for the requirements of the best management practice being evaluated. Second, the sites must present a realistic opportunity to install, operate and observe the devices being evaluated. Third, the sites must be located in hydraulic proximity to sensitive receiving waters. Fourth, the sites must be owned and operated by Caltrans. Fifth, sites located within the

target watershed were given higher priority in the selection process. Lastly, the sites must be projected to be operational as of December 1, 1998 and for at least two years after that date.

Safety concerns dictate several siting criteria, including the reservation of a 30 foot clear recovery zone (for motorist safety) around the perimeter of the basin. In addition, the basin must be protected by guard rail behind the edge of shoulder, and a second 'k'-rail at the periphery of the 30-foot clear zone. Other criteria, such as maintenance access and suitable site topography must also be satisfied. A section of the California Highway Design Manual and a Memorandum from Caltrans District 7 document the basis for the safety setback and are contained in Appendix D.

The placement of infiltration BMPs adjacent to bridge structures must be carefully evaluated since saturation of the area around a bridge column or abutment could reduce the foundation load capacity. A 100-foot setback criterion was developed for the purpose of siting infiltration BMPs in the vicinity of bridge structures. Use of this setback is considered the minimum safe distance for which a more detailed site structural and geotechnical investigation would not be required. A memorandum documenting the basis for this setback is contained in Appendix D.

The design and use of Caltrans facilities also influences the suitability of sites for installation of particular best management practices. For instance, several maintenance stations were designed to sheet flow their runoff to nearby public streets. These facilities lack on-site drain inlets and storm drain systems which might be retrofitted with such devices as media filters. In addition, several Caltrans facilities have been designed and constructed with multiple drainage areas and discharge points. This reduces flows and concentrations of potential pollutants to any particular discharge point. Furthermore, several maintenance stations are small and lack the heavy equipment associated with road crews. The lack of heavy equipment reduces the likelihood of sufficient oil and grease to justify installation of specific devices such as oil/water separators.

Specific criteria related to each type of best management practice are presented in Chapters 2 through 8 of this report. Other considerations in choosing sites include: 1) the relative amounts of potential pollutants estimated to be generated and transported to the receiving waters; and 2) the relative sensitivity and proximity of the receiving waters to these potential pollutants at the proposed site. These factors have been considered based on a review of Caltrans highway runoff data and highway runoff literature, desktop and field reconnaissance of Caltrans facilities and professional judgment. The information determined through desktop and field analysis was evaluated using a weighted decision matrix process.

## **1.4 Target Watershed for Retrofit Pilot Projects**

Caltrans has proposed the Carlsbad Hydrologic Unit, as defined by San Diego Regional Water Quality Control Board, as the primary target watershed for locating and constructing the five retrofit pilot projects. If detailed site investigation of Caltrans right-of-way within the primary target watershed proved that no adequate sites for any of the five pilot projects could be found, some of the projects were located in other watersheds. The Penasquitos Hydrologic Unit was considered as a first alternative for locating the remaining pilot projects. Again, all selected bmp sites can be seen on maps in Exhibits A and B at the end of this chapter.

### ***1.4.1 Target Watershed***

The Carlsbad Hydrologic Unit is an area of approximately 210 square miles in northwestern San Diego County. All or portions of the cities of Carlsbad, Encinitas, Escondido, Oceanside, San Marcos and Vista are included in the watershed. The Carlsbad Hydrologic Unit consists of the following hydrologic areas and sub-areas: Loma Alta, Buena Vista Creek, El Salto, Vista, Agua Hedionda, Los Monos, Buena, Encinas, San Marcos, Batiquitos, Richland, Twin Oaks, Escondido Creek, San Elijo, Escondido, and Lake Wohlford. It contains a variety of sensitive water resources, including coastal lagoons and perennial freshwater streams.

Caltrans facilities within the Carlsbad Hydrologic Unit include portions of I-5 (Post Miles 36 - 52) between Oceanside and Solana Beach, State Route 78 (Post Miles 0 - 17) connecting I-5 and I-15, and I-15 (Post Miles 26 - 36). In addition there are two maintenance facilities located within the target watershed: Carlsbad and Escondido Maintenance Stations. All Caltrans facilities are located within urbanized area of San Diego County.

### ***1.4.2 Alternative Watersheds***

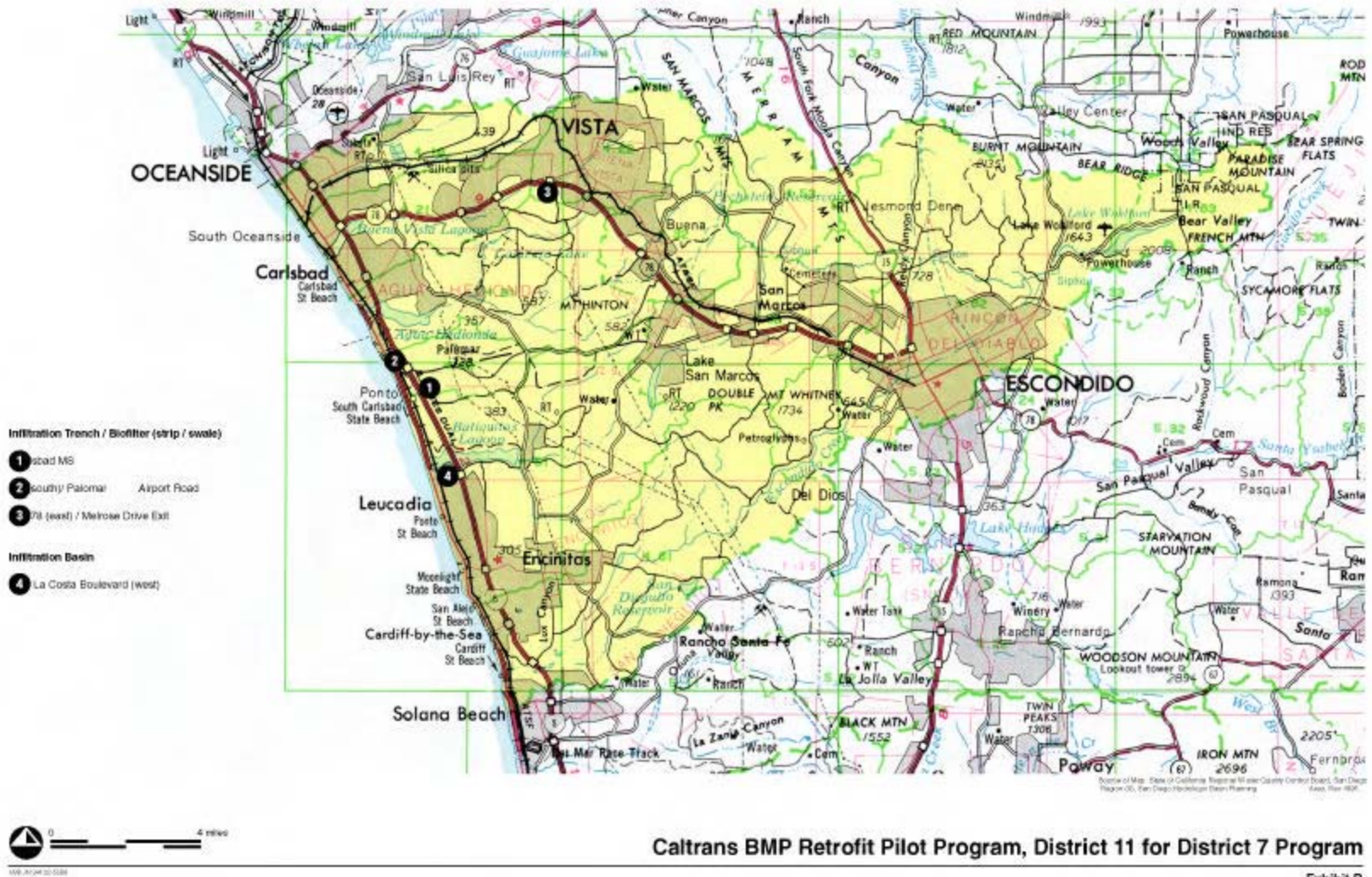
Priority was given to the Penasquitos Hydrologic Unit as the secondary target watershed. Penasquitos Hydrologic Unit has an area of approximately 170 square miles. All or part of the cities of Del Mar, Poway and San Diego are within this watershed. The Penasquitos Hydrologic Unit consists of the following hydrologic areas and sub-areas: Miramar Reservoir, Poway, Scripps, Miramar and Tecolote. The Penasquitos Hydrologic Unit drains into Mission Bay (303 (d) listing). Los Penasquitos Lagoon (303(d) listing) is located in the Unit.

Caltrans facilities within the Penasquitos Hydrologic Unit include portions of Interstate 5, 15 and 805, State Routes 52, 67 and 274, and the Kearny Mesa Maintenance Facility.



The siting process for pilot retrofit projects within District 11 has been conducted in conformance with the *Caltrans Target Watershed Proposal*, with primary emphasis given to locating retrofit pilot projects within the target watershed.





Caltrans BMP Retrofit Pilot Program, District 11 for District 7 Program



## Caltrans BMP Retrofit Pilot Program, District 11 for District 7 Program

Exhibit C



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## **2.0 Extended Detention Basins**

As part of the District 11 Retrofit Pilot Program, Robert Bein, William Frost & Associates (RBF) has selected three sites for extended detention basins to evaluate the feasibility and effectiveness of this type of best management practice in removing potential pollutants from urban road and highway runoff. The Retrofit Pilot Program proposal indicates the construction of one extended detention basin project and three infiltration basin projects. However, due to poor infiltration rates and high groundwater at the preferred sites, only one infiltration basin could be sited (*see Chapter 5.0 of this report on Infiltration Basins*). It is proposed that two extended detention basin projects be substituted for two infiltration basin projects.

Extended detention basins are basins that hold runoff for at least 24 hours for the purpose of removing sediment and particulate forms of other potential pollutants. Particulate matter settles out of water held within the basin for a period of time. For this study, a detention period of 48-72 hours has been specified. Extended detention basins are designed to remain dry, except during a runoff event and a specified detention period after the runoff event.

Extended detention basin outlets may require energy dissipaters and downstream receiving channel stabilization. These actions would mitigate scouring in the downstream channel that could otherwise produce sediment in the receiving waters.

Storm water runoff constituent removal efficiencies, as well as operational and maintenance experience, will be monitored for a period of two years.

The research objectives of this pilot project are to investigate the feasibility and performance of extended detention basins for use along Caltrans freeways and highways. The basic water quality objectives of an extended detention basin are to remove sediment and suspended materials. Some heavy metals in particulate form, toxic materials, and oxygen demanding materials can also be removed. Extended detention can remove up to 90 percent of particulates if storm water is retained for more than 24 hours.

### **2.1 Site Selection Process**

The site evaluations required field reconnaissance, site surveys and geotechnical evaluations of Caltrans-owned land adjacent to highways and freeways within the priority watersheds in District 11. Field surveys and geotechnical evaluations provided information on location, available space, tributary area, maintenance access, proximity to structures, depth to water table, and soil characteristics. In addition, the sites were surveyed by RBF and Caltrans personnel.

The main considerations in choosing the location of an extended detention basin pilot project were: 1) location within the target watershed; 2) availability of adequate space; 3) proximity to a state highway or freeway; 4) proximity to receiving waters; 5) suitability of the existing storm drain configuration; and 6) maintenance access. Sites that were outside of Caltrans right-of-way were not considered in this study.

Safety concerns dictate several siting criteria, including the reservation of a 30 foot clear recovery zone (for motorist safety) around the perimeter of the basin. In addition, the basin must be protected by guard rail behind the edge of shoulder, and a second 'k'-rail at the periphery of the 30 foot clear zone. Other criteria, such as maintenance access and suitable site topography must also be satisfied. A section of the California Highway Design Manual and a Memorandum from Caltrans District 7 document the basis for the safety setback and are contained in Appendix D.

Site storm drain configuration refers to the arrangement of inlets, outlets, and conveyance routes. These may influence the design of the extended detention basin. The optimal drain inlet/outlet structure is an in-



line system where the inlet and outlet are located at opposite ends of the basin. The longer the flow length, the greater the constituent removal capacity. Care must also be taken to ensure that a backwater condition is not created for the existing upstream storm drain.

Depth to water table and soil characteristics were also considered. However, these factors were not as important for locating the extended detention basin pilot project as for locating infiltration basin pilot projects because extended detention basins can be sealed with liners making water table and soil characteristics irrelevant.

Size and shape considerations included the natural slope of the land and the acreage available. The basin site must be located at the watershed low point, and have a suitable outfall location. Also, areas that contain sufficient acreage, may not provide the necessary maintenance access. For example, some basin sites may not offer adequate maintenance access from the highway nor provide ample safety buffers between edge of basins and travelways (including on- and off-ramps). Extended detention basins require moderate to high levels of maintenance. Therefore, maintenance access is an important criterion in the site evaluation process.

The following sites were investigated:

Interstate 5 and La Costa Avenue Interchange East  
Interstate 5 and La Costa Avenue Interchange West  
Interstate 5 and Manchester Avenue Interchange East  
Interstate 5 and Manchester Avenue Interchange West  
Interstate 5 and State Route 56 Interchange  
**Interstate 15 and State Route 78 Interchange**

The sites were evaluated using a weighted decision matrix. Each site was evaluated and compared with respect to several different criteria or characteristic categories. Criteria were given a value, or weight (1-10) with respect to their importance and relevance to the site selection process. These criteria are explained in depth in Appendix C.

**The results of the evaluation process are summarized in Table 2-1. The sites that best fit all the criteria are: the Manchester Avenue and I-5 (east); the Interstate 5 and State Route 56 Interchange; and the Interstate 15 and State Route 78 Interchange, denoted in bold in Table 2-1 and further described in the following paragraphs. Field notes for each of the sites are provided in Appendix B.**



**Table 2-1**  
**Extended Detention Basin Site Selection Matrix**

<b>Site</b>	<b>Target Watershed</b>	<b>Space Available</b>	<b>Proximity to Receiving Water</b>	<b>Site Stormdrain Configur.</b>	<b>Maintenance Access</b>	<b>Total</b>
<i>Weight</i>	<i>7</i>	<i>10</i>	<i>10</i>	<i>8</i>	<i>8</i>	
I-5 and La Costa Blvd. (east)	10	5	8	6	7	304
I-5 and La Costa Blvd. (west)	10	9	10	6	7	364
<b>I-5 Manchester Ave. (east)</b>	<b>10</b>	<b>7</b>	<b>8</b>	<b>7</b>	<b>9</b>	<b>348</b>
I-5 Manchester Ave. (west)	10	6	8	7	8	330
<b>I-5/SR 56 Interchange</b>	<b>5</b>	<b>4</b>	<b>9</b>	<b>10</b>	<b>9</b>	<b>317</b>
<b>I-15/SR 78 Interchange</b>	<b>10</b>	<b>10</b>	<b>5</b>	<b>5</b>	<b>10</b>	<b>340</b>

The decision matrix indicates that the I-5/La Costa Avenue interchange (east) is the least desirable site for an extended detention basin. It scores poorly due to poor drainage and a large percentage of non-Caltrans inflow. The I-5/La Costa Avenue interchange (west) could accommodate an extended detention basin, however this site is currently being recommended for an infiltration basin because of suitable infiltration rates. The Manchester Ave. east and west sites both scored highly for extended detention basins and for wetponds. The larger size of the Manchester east site allows for better extended detention basin siting than the smaller Manchester west site. Therefore, the east site was selected as an extended detention basin, and the Manchester west site was set aside to be a wet pond. The I-5/SR 56 interchange was selected for the extended detention basin pilot project because it scored highest in the decision matrix. The I-15/SR 78 interchange was also chosen for an extended detention basin because it scored well in the matrix and was not selected for another pilot project. Reconfiguration of the drainage system at the I-5/SR 78 interchange site may be necessary since the head requirements of an extended detention basin may not be compatible with the upstream drainage system.

## **2.2 Site Description**

### ***2.2.1 I-5 at Manchester Avenue (East)***

The proposed basin location is within the area created by the northbound offramp from I-5 at Manchester Avenue. The site slopes to the southeast at from 5 to 10 % and toward the San Elijo Lagoon. Drainage tributary to the site is from the Manchester off-ramp and the northbound freeway lanes. About 2 acres (1.6 ha) of impervious surface are tributary to the site. The basin may be constructed in the loop area, discharging to Manchester Avenue and flowing under I-5 to a cross culvert that carries the stormwater flow under Manchester Avenue and discharges directly to the San Elijo Lagoon. *Figure 2-1* illustrates the general site location, and *Figure 2-2* indicates the current site outlet.



The receiving water for this site is the ***San Elijo Lagoon***. This waterbody is located in the target watershed. Currently the runoff from the I-5 and northbound exit ramp discharges directly to the Lagoon via a municipal storm drain system (30 yards in length).

The San Elijo Lagoon is a State Ecological Preserve. It is habitat for rare and endangered species and has been the subject of several scientific studies. San Elijo Lagoon has been directly impacted by the increased urbanization of northern San Diego County, resulting in a number of ecological problems including excessive freshwater flows, increased sedimentation, eutrophication and fecal contamination. Metals and organic pollutants have accumulated in the sediments. Closure of the lagoon mouth of the bay has lead to a variety of ecological problems including low dissolved oxygen and low salinity within the lagoon.

Beneficial uses of the coastal lagoon include recreation, estuarine habitat, wildlife habitat, biological habitat of special significance, rare or threatened species habitat, and spawning habitat.

### 2.1.2 I-5 at SR 56

Area located just off of the SR-56 eastbound/I-5 southbound connector. The site may be accessed via Carmel Valley Road, just off the I-5 freeway. The Interstate 5/State Route 56 interchange is located in central coastal area of San Diego County in the Carmel Valley which is in the northern portion of the Penasquitos Hydrological Unit. This is one of two BMPs that was sited in the secondary watershed. The most viable sites for extended detention basins were already being utilized in the target watershed. The next best site was determined to be at this sensitive lagoon.

The site was estimated by field observation to be approximately 0.25 acres (.1 ha). The watershed area tributary area to the site is approximately four acres (1.6 ha) from the southbound I-5 and the new SR 56 southbound connector. The I-5/SR 56 is a new interchange that is scheduled to be operational by June 1998, which is consistent with the schedule for the monitoring component of the Retrofit Pilot Project. The proposed extended detention basin site is equipped with compatible drainage facilities, including an existing 24-inch (70 cm) storm drain outlet from the inlets on the I-5/SR 56 transition. The selected site is shown in *Figures 2-3 and 2-4*.

The receiving water is the **Los Penasquitos Lagoon** at the mouth of Soledad Creek in the Torrey Pines State Reserve. The receiving waters are subjected to runoff from residential areas, commercial structures and the highway system. This site receives stormwater runoff from the I-5 highway and the interchange with SR56 currently under construction. A box culvert passing beneath I-5, serving the upstream tributary area, drains directly into the Los Penasquitos Lagoon. The discharge point to the lagoon is from the BMP site is overland across Old Sorrento Road, with virtually no intermediate buffer zone.

Beneficial uses of the coastal lagoon include recreation, estuarine habitat, wildlife habitat, biological habitat of special significance, rare or threatened species habitat, and spawning habitat. The lagoon is currently listed in the Region 9 basin plan as providing habitat for threatened and endangered species. Restricted water circulation means there is little physical flushing during high flow events. The extensive marsh vegetation is subjected to nutrient inputs stimulating eutrophication. Several studies have found high bacterial levels entering the lagoon. Metals and organic pollutants have accumulated in the sediments. Regional water Quality Control Board Order 90-42 (NPDES Permit No. 0108758) lists water quality impairments of nutrient and sediment loading.



Figure 2-3 (Tributary area inlet)

Figure 2-4 (Site location)

### 2.1.3 SR 78 at I-15

The site is located in a large basin bounded by the SR 78 on the north, the I-15 on the east, and the I-15 north connector to the SR 78 east, on the south-west. The interchange is located in Escondido, San Diego County. The selected site is shown in *Figures 2-5 and 2-6*.

The site was estimated by field observation to be approximately 1 acre. The proposed extended detention basin receives drainage from a 24-inch (60 cm) culvert pipe, which routes runoff from an estimated tributary area of eight acres (3.2 ha) from the SR 78 (westbound). The inlet culvert is low and may need to be modified.

The receiving water is ***Escondido Creek***, a freshwater stream running through the City of Escondido. Escondido Creek is part of the ***San Elijo Lagoon*** watershed. The hydraulic connection is direct, through a storm drain pipe and channel system which is approximately 7,000 feet long.

Beneficial uses of Escondido include municipal and agricultural use, hydropower generation, recreation, and warm, cold and wildlife habitat. Escondido Creek encompasses an extremely large drainage area and is highly urbanized in some locations, and rural in others. Shortly downstream of the lined reach, the Creek reverts to a natural state, and the perennial base flow indicates that the Creek may support a fishery at this location.

The San Elijo Lagoon is a State Ecological Preserve. It is habitat for rare and endangered species and has been the subject of several scientific studies. San Elijo Lagoon has been directly impacted by the increased urbanization of northern San Diego County, resulting in a number of ecological problems including excessive freshwater flows, increased sedimentation, eutrophication and fecal contamination. Metals and organic pollutants have accumulated in the sediments. Closure of the lagoon mouth of the bay has lead to a variety of ecological problems including low dissolved oxygen and low salinity within the lagoon. Beneficial uses of the coastal lagoon include recreation, estuarine habitat, wildlife habitat, biological habitat of special significance, rare or threatened species habitat, and spawning habitat.



Figure 2-5 (Site location)



Figure 2-6 (Current  
site outlet)

### **3.0 Infiltration Trenches**

As part of the District 11 Pilot Retrofit Program, RBF investigated Caltrans maintenance stations in District 11 with the goal of selecting two sites for the purpose of evaluating the feasibility and effectiveness of installing infiltration trenches.

An infiltration trench is typically a long and narrow excavation, which is lined with filter fabric and backfilled with stone aggregates, gravel, or sand to form an underground basin. Runoff is diverted into the trench and exfiltrates into the soil. Infiltration trenches effectively remove soluble and particulate pollutants from surface runoff for the portion of the storm flow that is infiltrated to the soil.

During the study, the trench effectiveness, in addition to operation and maintenance requirements, problems and procedures, will be monitored for a two-year period. The District 11 Retrofit Pilot Studies Proposal indicates that two trenches will be sited in conjunction with biofilters at Maintenance Stations or Park and Ride facilities.

#### **3.1 Characteristics of Infiltration Trenches**

Infiltration trenches require permeable soils or subsoils to allow for infiltration. A minimum infiltration rate of greater than or equal to 7 mm/hr (0.27 in/hr,  $6.25 \times 10^{-6}$  ft/s) is required, which corresponds with sand, loamy sand, sandy loam, loam, and silt loam soil groups.

Infiltration trenches are prone to clogging by deposited solids and therefore should not be used to trap sediments. Special inlets or grass buffers can be used to capture sediment before it enters an infiltration trench.

While infiltration trenches provide the advantage of allowing groundwater recharge, the possibility for low levels of ground-water contamination has been noted for nitrates, chlorides and gasoline. Sufficient separation from groundwater should be maintained to protect groundwater resources. Monitoring of groundwater in the vicinity of the trench will be one of the research objectives of the program.

A drainage area of less than ten acres (4 ha) is recommended. The slope of the bottom of the trench should be approximately zero. Ample distance away from wells and structural foundations should be provided. The bottom of the facility should be at least four feet (1.2 m) above bedrock and two to four feet (1.2 m) above the seasonally high water table.

The trench design is a *water quality exfiltration system*, which is volumetrically designed to handle and exfiltrate the design storm volume. Storms of greater magnitude than the design storm volume will bypass the facility.

### **3.2 Site Selection Process**

The site selection process began by meeting with Caltrans officials to request site plans and related information. Caltrans assisted with field investigations of the maintenance stations including tours of the grounds, photos, and observations of drainage patterns and general housekeeping practices. Appendix B contains site notes for all sites visited.

This information was then evaluated using a weighted decision matrix process. Each site was evaluated and compared with respect to several different criteria and characteristic categories. Each criteria or characteristic category was given a value, or weight (1-10) with respect to its importance and relevance to the site selection process.

The characteristics determined to be important were the following:

- space available to place the trench and biofilter;
- proximity to adjacent structures and slopes;
- proximity to receiving water bodies;
- drainage patterns of site;
- type of maintenance activities and equipment storage at the yard; and
- sediment and debris accumulation potential.

Safety concerns dictate several siting criteria, including the reservation of a 30 foot clear recovery zone (for motorist safety) around the perimeter of the basin. In addition, the basin must be protected by guard rail behind the edge of shoulder, and a second 'k'-rail at the periphery of the 30 foot clear zone. Other criteria, such as maintenance access and suitable site topography must also be satisfied.. A section of the California Highway Design Manual and a Memorandum from Caltrans District 7 document the basis for the safety setback and are contained in Appendix D.

The placement of infiltration BMPs adjacent to bridge structures must be carefully evaluated since saturation of the area around a bridge column or abutment could reduce the foundation load capacity. A 100 foot setback criteria was developed for the purpose of siting infiltration BMPs in the vicinity of bridge structures. Use of this setback distance is considered the minimum safe distance for which a more detailed site structural and geotechnical investigation would not be required. A memorandum documenting the basis for this setback is contained in Appendix D. This criterion is subject to further consideration based on detailed structural and geotechnical analysis and measurements during the siting of potential future permanent infiltration trenches.

The site characteristic values were assigned for each category at each site. For example, proximity to structures is very important in locating trenches at maintenance stations. Infiltration is not allowed in the vicinity of bridge columns for structural reasons, consequently, stations located under bridges would receive very low scores in this

category. Each site was then rated by developing a composite score, representing all of the individual characteristic categories, as shown in Table 3-1. The selection criteria area discussed in detail in Appendix C.

The sites investigated within District 11 for infiltration trench feasibility were as follows:

6. Maintenance Stations

- **Carlsbad**
- Chula Vista
- Camino Del Rio
- **Escondido**
- Imperial
- **Kearny Mesa**
- Otay
- Pacific Highway
- Santee
- Coronado Bridge

7. Park and Ride Lots

- La Costa Ave
- Highway 78/I-5
- Carmel Valley Rd.
- Route 78/College Blvd.
- College Blvd. South
- Birmingham Dr./I-5
- El Norte – 15

The potential sites that scored well in the decision matrix included La Costa Avenue Park and Ride, Highway 78 at Interstate 5 Park and Ride, and Carmel Valley Road Park and Ride. La Costa Avenue and Highway 78 have been selected as media filter sites. They are exceptionally suited to retrofit of this BMP, with existing underground drainage systems in place and sufficient area to construct the media filter vault. The Carmel Valley Road Park and Ride also scored well in the decision matrix due to its location in the secondary watershed and proximity to a sensitive receiving water. However, space is at a premium at this relatively small site, and drainage patterns do not easily facilitate a trench installation. Further, this facility is located in the construction zone of the new I-5/SR 56 interchange, and currently serves as a contractor staging area. Construction in this area is likely to be ongoing over the next several years as Sorrento Valley Road is rebuilt and the improvements to the interchange are completed.

The 3 sites with the highest composite scores were chosen for further consideration and are denoted in bold above. These sites were evaluated by a geologist and investigated using exploratory drilling for suitability relative to infiltration rate, distance to groundwater, distance to bedrock, and proximity to structures that could be impacted by infiltration.



**Table 3-1  
Site Selection Matrix**

Site	Type Activities	Target Watershed	Drainage Pattern	Space Available	Proximity to Structures	Proximity to Rec. Water	Total
<i>Weight</i>	6	7	7	10	10	10	
<b>8. Maintenance Stations</b>							
<b>Carlsbad</b>	<b>8</b>	<b>10</b>	<b>9</b>	<b>8</b>	<b>6</b>	<b>7</b>	<b>391</b>
Camino Del Rio	5	0	5	6	6	6	245
Chula Vista	9	0	5	7	7	5	279
<b>Escondido</b>	<b>8</b>	<b>10</b>	<b>9</b>	<b>8</b>	<b>8</b>	<b>5</b>	<b>391</b>
Imperial	5	0	7	6	7	5	259
<b>Kearny Mesa</b>	<b>8</b>	<b>5</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>5</b>	<b>349</b>
Otay	4	0	3	6	7	5	225
Pacific Highway	4	0	7	5	6	5	233
Santee	7	0	7	7	7	5	281
Coronado Bridge	2	0	6	3	4	7	194
<b>9. Park and Ride Lots</b>							
La Costa Ave.	6	10	6	10	9	10	438
Highway 78/I-5	9	10	8	5	7	9	390
Carmel Valley Rd.	8	5	5	5	6	9	318
Route 78/College Blvd.	3	10	5	5	7	2	263
College Blvd. South	4	10	2	5	7	2	248
Birmingham Dr./I-5	4	10	3	5	6	2	245
El Norte/I-5	6	0	5	6	7	2	221



### **3.3 Site Descriptions**

#### ***3.3.1 Carlsbad MS***

The Carlsbad Maintenance Station is located in the City of Carlsbad one block south of Palomar Airport Road at 6050 Paseo Del Norte. The site is bounded by Paseo Del Norte to the west and commercial and industrial uses to the south, east and north. Site drainage is sheet flow to concrete swales and gutters, concentrating along a gutter in the entrance drive to the Station and ultimately discharging to Paseo Del Norte. The site includes a vehicle maintenance shop, fueling island, wash rack and storage areas for maintenance equipment and supplies. *Figure 3-1* provides a view of the overall site, and *Figure 3-2* indicates the proposed location of the infiltration trench.



*Figure 3-1 (Carlsbad MS)*



*Figure 3-2 (Trench site)*

The site is tributary to ***Encinas Creek***, which discharges directly to the Pacific Ocean. Drainage is sheet flow to concrete swales and gutters, concentrating along a gutter in the entrance drive to the Station and ultimately discharging to Encinas Creek, about one-quarter mile to the south of the site.

Encinas Creek contributes to an ocean outfall that is located near popular swimming beaches. This pilot project would treat the runoff from one of the two maintenance stations in the Carlsbad Hydrologic Unit.

#### ***3.3.2 Escondido MS***

The Escondido Maintenance Facility is located at 1780 West Mission Avenue in the City of Escondido, one block west of SR 78 at Nordahl Road. The site is bounded by industrial uses to the east and west, SR 78 to the north and Mission Avenue to the south. Site uses include a fueling island, maintenance shop, storage and parking of heavy equipment, an equipment wash rack, and storage of roadway repair materials such as aggregate base (AB) and asphalt concrete (AC). The site drainage patterns are sheet flow

to two primary drainage facilities, a culvert located about midway along the westerly property line, and a drain inlet located near Mission Avenue at the front of the site. *Figure 3-3* provides a view of the overall site, and *Figure 3-4* indicates the proposed location of the infiltration trench.



Figure 3-3(Escondido MS)



Figure 3-4(Trench Site)

The Escondido MS discharges to *Escondido Creek*. The maintenance station discharges through a municipal storm drain system approximately three miles in length to Escondido Creek. The discharge occurs at the point where Escondido Creek is concrete lined.

Beneficial uses of the creek include municipal and agricultural use, hydropower generation, recreation, and warm, cold and wildlife habitat. Escondido Creek encompasses an extremely large drainage area and is highly urbanized in some locations, and rural in others. Shortly downstream of the lined reach, the Creek reverts to a natural state, and the perennial base flow indicates that the Creek may support a fishery at this location. This creek feeds into San Elijo Lagoon.

The San Elijo Lagoon is a State Ecological Preserve. It is habitat for rare and endangered species and has been the subject of several scientific studies. San Elijo Lagoon has been directly impacted by the increased urbanization of northern San Diego County, resulting in a number of ecological problems including excessive freshwater flows, increased sedimentation, eutrophication and fecal contamination. Metals and organic pollutants have accumulated in the sediments. Closure of the lagoon mouth of the bay has lead to a variety of ecological problems including low dissolved oxygen and low salinity within the lagoon. Beneficial uses of the coastal lagoon include recreation, estuarine habitat, wildlife habitat, biological habitat of special significance, rare or threatened species habitat, and spawning habitat.

### 3.3.3 Kearny Mesa

The Kearny Mesa Maintenance Station is located adjacent to the 805 Freeway at 7179 Opportunity Road in San Diego. The site is bounded by commercial uses to the east, Opportunity Road to the north, and the I-805 freeway to the south and west. Site drainage is divided into two main areas; the easterly portion of the site is tributary to drain inlets and an underground drainage system. The westerly portion of the site is tributary to an overside drain that discharges to a culvert passing under I-805. The proposed trench location is adjacent to the boundary of the station along I-805. Site uses include heavy equipment parking, equipment storage such as engine powered generators, vehicle fueling and an equipment washrack. *Figure 3-5* provides a view of the overall site, and *Figure 3-6* indicates the recommended location of the infiltration trench.



Figure 3-5 (Kearny Mesa MS)



Figure 3-6 (Trench Site)

The Kearny Mesa Maintenance Station is tributary, via Caltrans and downstream municipal storm drain systems, to ***Tecolote Creek*** and ***Mission Bay***. The discharge path to Mission Bay is sufficiently buffered by a distance of 5 miles of municipal storm drain system and intermediate reaches of natural creek.

Tecolote Creek is a freshwater stream that provides warm water habitat and vegetation for wildlife. Stormwater runoff samples from Tecolote Creek typically contain elevated levels of nitrogen, total coliform bacteria, and dissolved solids. These contaminants are carried into Mission Bay, a water body that is also impacted by bacterial contamination from dilapidated sewage pipes. Beneficial uses of Mission Bay include recreation, marine and estuarine habitat for wildlife and marine species.

This pilot project would treat the runoff from the largest maintenance station in San Diego County. Maintenance station activities have a potential to generate chemical constituents of concern to Tecolote Creek and Mission Bay.

### **3.4 Discussion of Geotechnical Investigation**

Field permeability tests were conducted for the three sites with the highest composite scores as shown in Table 3-2. The tests were conducted by first drilling a 10 inch (25.4 cm) diameter core to refusal (bedrock) or until groundwater was encountered, or to a depth sufficiently below the bottom of the trench if neither of the aforementioned conditions was encountered to adequately understand the local site lithology. Typically, the maximum drilling depth was about 30 to 35 feet (9.1 to 10.6 m).

The drill holes were subsequently backfilled with bentonite chips to a depth below ground surface (bgs) of about 15 feet (4.6 m). A 4-inch (10.16 cm) well screen was inserted and backfilled with gravel to a depth of about 5 feet (1.5 m) bgs, permeable backfill was also placed between the well screen and the core hole wall. The remaining 5 feet (1.5 m) to the ground surface was backfilled with bentonite chips surrounding a 3-inch (7.6 cm) diameter brass pipe used to introduce water to the test zone (from 5 to 15 feet bgs). Samples of soils were taken at 6 feet (1.8 m), 10 feet (3.0 m) and 15 feet bgs (4.6 m) for later laboratory permeability tests. The results of the field permeability tests for the selected sites are given in Table 3-2.

**Table 3-2**  
*Results of Permeability Tests*

Carlsbad MS	Escondido MS	Kearny Mesa MS
2.8(10 <sup>-5</sup> ) ft/s	Groundwater	7.7(10 <sup>-8</sup> ) ft/s
8.7(10 <sup>-4</sup> ) cm/s	Groundwater	2.4(10 <sup>-6</sup> ) cm/s

The infiltration rate for the Carlsbad MS is suitable for an infiltration trench installation. The minimum infiltration value commonly quoted in literature for a trench installation is about 6.25(10<sup>-6</sup>)ft/s or 1.94(10<sup>-4</sup>)cm/s. The infiltration rate at Kearny Mesa is substantially below the values indicated for acceptable infiltration. The Escondido site was drilled for an in-field permeability test. Groundwater was encountered within three feet (.91 m) of the ground surface, rendering the site infeasible for an infiltration trench installation. Further investigation at the Escondido site was discontinued. The geotechnical information for each site is contained in Appendix A. Additionally, a letter from the Geotechnical Engineer with an evaluation of the primary maintenance stations in District 11 is included in Appendix A. This letter indicates that four maintenance, in addition to the three stations previously tested, have good/fair permeability. These sites, located outside the target and secondary watersheds, are the Chula Vista MS, Camino del Rio MS, Pacific Highway MS and the Coronado Bridge MS. Each of these stations with the exception of Chula Vista are small, housing only landscape crews and are located either partially or wholly under bridges. The Chula Vista MS has an area of about 4.2 acres (1.7 ha) and is completely exposed. However, most of the runoff (70 to 80%) drains as sheet flow through the front gate of the facility. Consequently, further

geotechnical investigation and permeability testing is not recommended due to the physical site constraints.

### **3.5 Conclusions**

Each of the Maintenance stations and most of the Park and Ride facilities in District 11 in the primary and secondary target watersheds were visited and reviewed with respect to the potential for siting of an infiltration trench. The three primary sites, selected from a weighted decision matrix process, were selected for further feasibility investigation with a field infiltration study and geotechnical review of the site. The results of the field infiltration tests indicate that only one of the selected sites, Carlsbad MS is suitable for infiltration due to low and extremely low infiltration rates or high groundwater. The compost media filter is proposed as a substitute for the second infiltration trench (see Chapter 8).

In general, maintenance stations located in older terrace deposits will generally exhibit poor permeability, with old alluvium exhibiting rates, which are also most likely too low for a suitable trench site. Locations with young alluvium are potentially suitable. Young alluvium is located in or near river bottoms or alluvial fan areas, and near the coast. In addition to infiltration testing at the facilities described herein, other infiltration tests were completed at two locations at Manchester Avenue at I-5, and one location at Highway 78 at I-15. A field review by a geologist was conducted at SR 56 at I-5.

Groundwater was encountered within 3 feet (.91 m) of the existing ground surface at Manchester Avenue, making the site unsuitable for infiltration. The infiltration rate at Highway 78 and I-15 was substantially below the recommended minimum, about  $2.4(10^{-5})$  cm/s as compared to  $1.94(10^{-4})$  cm/s recommended by the literature. The geologist has determined through field review of the site at SR 56 and I-5 that the local soils probably contain too much silt and clay to effective for infiltration.

## **4.0 Biofilters**

As part of the District 11 Pilot Retrofit Program, RBF has selected three Caltrans sites for the purpose of evaluating the feasibility and effectiveness of installing two biofiltration swales and one biofiltration strip. Site locations include Caltrans maintenance stations and freeways or highways.

Biofiltration swales and strips (biofilters) are defined as vegetated pathways where constituents are removed by filtration through grass, deposition in low velocity areas, and infiltration into the subsoil.

Biofilters typically are designed to remove suspended solids and metals associated with particulates, such as lead and zinc. Constituent removal efficiency is related to facility dimensions, longitudinal slope, and type of vegetation. Increased removal of solubles, particularly nutrients and soluble metals can be accomplished with reductions in flow rate, and increased contact time with swale vegetation.

Biofilters are commonly used as a pretreatment for other BMPs. Where they are used as such, the combination of BMPs are commonly referred to as a "treatment train." Infiltration devices, such as infiltration trenches often contain a biofilter pretreatment to increase overall constituent removal and long term efficiency.

### ***4.0.1 Biofiltration Swales***

Swales can be used to serve small areas, less than four hectares or 10 acres (4.0 ha) in size. They should not serve highly urbanized areas or construction sites where large volumes of runoff or high sediment loads can overwhelm the system. They should be used for areas with slopes no greater than five percent. The seasonable high water table should be between one and two feet (.3 and .6 m) below the surface. The site should be at least three meters (10 feet) from surrounding buildings.

The area required for a swale system varies depending on hydraulic residence time. Acceptable ranges for residence time are between 5-9 minutes (Young et al, 1996). Width varies from two to eight feet (.6 to 2.4 m), with a maximum of 10 feet if adequate infiltration length cannot be achieved (Young et al, 1996).

The topography of the site should permit the design of a channel with a slope and cross sectional area sufficient to maintain an appropriate flow velocity. Recommendations for longitudinal slopes range between .02 and 6 percent. Steep slopes may require energy dissipating and grade check to allow adequate detention time.

#### **4.0.2 Biofiltration Strips**

Biofilter strips, also known as vegetated buffer strips, are vegetated sections of land similar to grasses swales, except they are essentially flat with low longitudinal slopes (usually 2–4%), and are designed only to accept runoff as overland sheet flow. Dense vegetative cover facilitates conventional constituent removal through detention, filtration by vegetation, and infiltration into soil.

Successful performance of biofilter strips rely heavily on maintaining sheet flow. This ideally requires a limited drainage area of five to 12.5 acres (two to five hectares) with a flat surface immediately preceding the filter strip. Sites that do not convey sheet flow may require the addition of a level-spreading device for even distribution of runoff.

#### **4.1 Site Selection Process**

The site selection process began with a reconnaissance of Caltrans facilities in San Diego County, District 11. Initially, an attempt was made to locate two biofilters as pre-treatment devices for two infiltration trenches at Caltrans maintenance stations and two biofilters as pre-treatment devices for two infiltration basins. However, due to low infiltration rates only one location was found to be feasible to site an infiltration trench/biofilter combinations at District 11 maintenance stations (see Chapter 3) and no locations for an infiltration basin/biofilter combination. The I-5 and La Costa Blvd. (west) site proposed for infiltration basin installation can not accommodate biofilter due to limited space. Thus the siting of biofilters was refocused to Caltrans District 11 highways and freeways. (Field notes can be found in Appendix B).

The site selection process began with initial visual inspections of Caltrans facilities in District 11. Initial screening selection criteria included tributary area estimation, location of inlets and outlets, estimated slope, and Caltrans right-of-way availability.

Of the areas initially identified as feasible for installing biofilters, only a few sites were selected for possible further analysis based on evaluation using the initial screening criteria described above. The next phase of the selection process included more detailed site evaluations of drainage systems and patterns and meetings with Caltrans officials to request site plans and related information.

The sites selected for further consideration were then evaluated using a weighted decision matrix process. Each site was evaluated and compared with respect to several different criteria and characteristic categories. Each criteria or characteristic category was given a value, or weight (1-10) with respect to its importance and relevance to the site selection process.

The characteristics determined to be most significant in biofiltration site selection were the following:

- estimated soil type;
- tributary drainage area ;
- length of swale/strip;
- slope of swale/strip;
- proximity to the receiving water
- location within target watershed.

Site characteristic values were assigned for each category at each site with respect to the level of importance. For example, if the site contained a slope between 2 –5%, it would receive a score of 10. Conversely, the presence of runoff not linked to highways or freeways (offsite) would receive a low or no score. Each site is then rated by developing a composite score, representing all of the individual characteristic categories, as shown in Table 4-1. (The criteria rating system can be found in Appendix C).

The sites selected for second phase evaluation were as follows:

1. Carlsbad maintenance station (infiltration trench pre-treatment);
2. Kearny Mesa maintenance station;
3. I-5 Northbound shoulder (South of San Onofre Power plant);
4. I-5 Northbound shoulder before Canon Avenue offramp;
5. I-5 Southbound shoulder before Palomar Airport Rd.;
6. SR 78 Eastbound shoulder before Melrose Ave.



<b>Table 4-1: Secondary Biofiltration Site Selection Matrix</b>								
<i>Weight</i>		5	8	9	10	10	7	<i>Total weighted Value</i>
<b>Site Number</b>	<b>Possible Biofilter Method</b>	<b>Estimated Soil Type</b>	<b>Estimated Tributary Area</b>	<b>Length</b>	<b>Slope</b>	<b>Proximity to receiving water</b>	<b>Target Water- shed*</b>	
<b>1</b>	<b>Strip</b>	<b>10</b>	<b>6</b>	<b>6</b>	<b>8</b>	<b>7</b>	<b>10</b>	<b>372</b>
2	Strip, Swale	4	7	7	8	5	5	304
3	Strip, Swale	6	7	10	5	8	0	306
4	Swale	5	6	7	6	7	10	336
<b>5</b>	<b>Strip, Swale</b>	<b>9</b>	<b>8</b>	<b>10</b>	<b>8</b>	<b>7</b>	<b>10</b>	<b>419</b>
<b>6</b>	<b>Swale</b>	<b>5</b>	<b>7</b>	<b>8</b>	<b>7</b>	<b>7</b>	<b>10</b>	<b>363</b>

\*Primary watershed=10, Secondary watershed = 5, other = 0.

The following sites, denoted in bold in Table 4-1, were selected for biofiltration swale installations: I-5 Palomar Airport Rd (Site 5) and SR 78 Melrose Ave (Site 6). The Carlsbad Maintenance Station (site 1) from Table 4-1 was selected for a biofiltration strip installation.

## 4.2 Site Descriptions

### 4.2.1 Carlsbad MS (Biostrip)

The Carlsbad Maintenance Station is located in the City of Carlsbad 1 block south of Palomar Airport Road at 6050 Paseo Del Norte. The site is bounded by Paseo Del Norte to the west and commercial and industrial uses to the south, east and north. Site drainage is sheet flow to concrete swales and gutters, concentrating along a gutter in the entrance drive to the Station and ultimately discharging to Paseo Del Norte. The site includes a vehicle maintenance shop, fueling island, wash rack and storage areas for maintenance equipment and supplies. *Figure 4-1* provides a view of the overall site, and *Figure 4-2* indicates the proposed location of the infiltration trench.



*Figure 4-1 (Carlsbad MS)*



*Figure 4-2 (Trench site)*

Carlsbad MS is a candidate site for an infiltration trench. The location of the biostrip would be adjacent to the trench as a pre-treatment device.

The site is tributary to ***Encinas Creek***, which discharges directly to the Pacific Ocean. Site drainage is not direct. Drainage is sheet flow to concrete swales and gutters, concentrating along a gutter in the entrance drive to the Station and ultimately discharging to Encinas Creek, about one-quarter mile to the south of the site.

Encinas Creek contributes to an ocean outfall that is located near popular swimming beaches. This pilot project would treat the runoff from one of the two maintenance stations in the Carlsbad Hydrologic Unit.

#### ***4.2.2 I-5 Southbound, Palomar Airport Rd.***

The proposed biofiltration swale site is located along the I-5 Southbound shoulder prior to the Palomar Airport Road offramp. Access to the area can be achieved from the I-5 Southbound shoulder. The site receives approximately 6 acres (2.4 m) of runoff from the I-5 Southbound mainline. The site currently consists a 30-foot (9.1 m) shoulder, which drains freeway runoff via sheetflow to an adjacent frontage road storm drain.

The proposed location for the biofiltration swale is along the area parallel to the I-5 freeway. This area contains a longitudinal slope of approximately 1-2% and a cross slope of 2%. *Figure 4-3* indicates the proposed swale location, *Figure 4-4* indicates the general site drainage facility.



Figure 4-3 (Site Area)



Figure 4-4 (Drain Inlet)

This site is tributary to the same receiving water as the Carlsbad Maintenance station.

#### 4.2.3 SR 78 Eastbound, Melrose Ave.

The proposed biofiltration swale site is located along the SR 78 Eastbound shoulder prior to the Melrose Avenue offramp. The site can be accessed from the SR 78 Eastbound shoulder. The site receives approximately 5 acres (2.0 ha) of runoff from the I-78 freeway. The site currently contains a 20-60 foot (6.1-18.3 m) shoulder, which drains into a drain inlet. The drain inlet runs underneath the frontage road and out to an unnamed stream. *Figure 4-6* indicates the proposed swale location, *Figure 4-5* shows the general site proximity.



Figure 4-5 (Site Area)



Figure 4-6 (Swale Site)

The swale will eventually terminate into the same stream as the drain outlet. This area contains an estimated longitudinal slope of 1-3% and a cross slope of 2%.

The site is tributary to **Buena Vista Creek** that parallels SR 78 and ultimately discharges into **Buena Vista Lagoon**. The site currently contains a 20-60 foot (6.1-18.3 m) shoulder, which drains into a drain inlet. The drain inlet runs underneath frontage road about 50 feet before being discharged to Buena Vista Creek.

Buena Vista Creek maintains nearly perennial flow at the point of discharge from the proposed site, an indication that fisheries may be supported. Buena Vista Lagoon is a 303(d) listed water waterbody due to impairments to aquatic life from excess sediment and elevated nutrient levels. It is also impaired for recreation due to high coliform count.

## **5.0 Infiltration Basins**

As part of the District 11 Pilot Retrofit Program, RBF has reviewed Caltrans freeways and highways for the purpose of selecting three sites to evaluate the feasibility and effectiveness of installing infiltration basins.

An infiltration basin is excavated depression. It captures a specified design storm and allows runoff to percolate into the ground through permeable soils. Infiltration basins are generally dry except immediately following storms. As the stormwater percolates into the ground, physical, chemical, and biological processes occur, which remove both soluble and small particulate constituents. Constituents are trapped in the upper layers of the soil.

Infiltration basin outlets may require energy dissipaters and downstream receiving channel stabilization. These actions would mitigate scouring in the downstream channel that could otherwise produce sediment in the receiving waters.

Storm water runoff constituent removal efficiencies, in addition to operation and maintenance, will be monitored for a two-year period.

Infiltration basins require permeable soils or subsoils to allow for infiltration. A minimum infiltration rate of greater than or equal to 7 mm/hr ( $1.94 \times 10^{-4}$  cm/s) is required, which corresponds with sand, loamy sand, sandy loam, loam, and silt loam soil groups.

Infiltration basins are usually used for drainage areas up to 50 acres (20.2 ha). The basins must be between 0.6 and 1.2 m (2 to 4 feet) above the seasonable high water table. They should not be located within 30 meters (100 feet) of drinking water wells to avoid possible contamination. Basins should be at a minimum of 3 meters (10 feet) down-gradient or 30 meters (100 feet) up gradient from building foundations. Basins should be located down gradient from highway pavement to avoid infiltration to the pavement edge-drain system. The slope of the contributing drainage basin should be no more than 20%. (Federal Highway Administration, *Evaluation and Management of Highway Runoff*, Publication No. FHWA-PD-96-032, U.S. Department of Transportation, June 1996).

### **5.1 Site Selection Process**

The site selection process began with a reconnaissance of Caltrans highways and freeways in San Diego County, District 11. Site evaluations included an initial feasibility investigation, followed by a more detailed site investigation.

Feasibility investigations to determine areas owned by Caltrans along freeway and highway interchanges, and on-ramp and off-ramps were first performed. The feasibility investigation included review of topographic mapping to identify potential sites. Viable candidate sites from the feasibility phase were further investigated to determine available area, and estimated tributary watershed through a field review process. Adequacy of the site was determined by estimating the required basin surface area (a function of tributary area) and including safety setback limits required by Caltrans. If these criteria were satisfied, further site investigation was considered. (Field notes can be found in Appendix B.)

Safety concerns dictate several siting criteria, including the reservation of a 30 foot clear recovery zone (for motorist safety) around the perimeter of the basin. In addition, the basin must be protected by guard rail behind the edge of shoulder, and a second 'k'-rail at the periphery of the 30 foot clear zone. Other criteria, such as maintenance access and suitable site topography must also be satisfied. A section of the California Highway Design Manual and a Memorandum from Caltrans District 7 document the basis for the safety setback and are contained in Appendix D.

The placement of infiltration BMPs adjacent to bridge structures must be carefully evaluated since saturation of the area around a bridge column or abutment could reduce the foundation load capacity. A 100 foot setback criteria was developed for the purpose of siting infiltration BMPs in the vicinity of bridge structures. Use of this setback distance is considered the minimum safe distance for which a more detailed site structural and geotechnical investigation would not be required. A memorandum documenting the basis for this setback is contained in Appendix D. This criteria is subject to further consideration based on detailed structural and geotechnical analysis and measurements during the siting of potential future permanent infiltration trenches.

Further investigation consisted of a preliminary geotechnical review and obtaining grading and drainage plans from Caltrans.

This information was then evaluated using a weighted decision matrix process. Each site was evaluated and compared with respect to several different criteria or characteristic categories. Most criteria were given a value, or weight (1-10) with respect to its importance and relevance to the site selection process. (The rating system for scoring sites on each criterion is located in Appendix C.)

The characteristics determined to be important for siting infiltration basins are the following:

- estimated soil type (1-10);
- tributary drainage area (1-10);



- sufficient area for siting the infiltration basin (1-10);
- location away from building foundations and highway pavement (1-10);
- modification needed to existing drainage system (1-10); and
- maintenance access (1-10).

The sites investigated within District 11 are given in Table 5-1. The four best sites indicated in bold face type in the Table were the subject of a detailed geotechnical investigation to determine in-field permeability rates and distance to the water table.

**Table 5-1**  
**Infiltration Basin Decision Matrix**

Site	Estimated Soil	Target Watershed	Space Available	Proximity to Structures	Maintenance Access	Proximity to Rec. Water	Total
<i>Weight</i>	6	7	10	10	8	10	
I-5 and La Costa Blvd.(East)	8	10	5	7	7	8	374
<b>I-5 and La Costa Blvd.(West)</b>	<b>9</b>	<b>10</b>	<b>9</b>	<b>7</b>	<b>7</b>	<b>10</b>	440
I-5/SR 56 Interchange	5	5	4	7	9	9	337
<b>I-5/Manchester Ave. (East)</b>	<b>9</b>	<b>10</b>	<b>7</b>	<b>7</b>	<b>9</b>	<b>8</b>	416
<b>I-5/Manchester Ave. (West)</b>	<b>9</b>	<b>10</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>8</b>	398
I-5/San Dieguito River	8	5	8	6	2	8	319
<b>SR78/I-15</b>	<b>5</b>	<b>10</b>	<b>10</b>	<b>9</b>	<b>10</b>	<b>5</b>	420

## **5.2 Discussion of Geotechnical Investigation**

In-drill hole field permeability tests were conducted at the selected sites to determine if the site soils possess suitable infiltration rates for the construction of an infiltration basin. The investigation also determined the location of the seasonal high water table relative to the existing grade.

### ***5.2.1 I-5 at La Costa Blvd. (West)***

Initially, it was assumed that the groundwater elevation at this site would preclude its use for infiltration. Two borings about 50 feet (15.2 m) apart were drilled in the vicinity of the proposed basin area. The groundwater elevation was measured at 8 feet (2.4 m) below ground surface (bgs) and 9 feet (2.7 m) bgs for each of the test holes respectively.

The depth to the water table was re-measured about 1 week later at high tide to ensure that local groundwater fluctuations did not significantly alter the depth to the free water surface. The second measurement indicated that the depth to the water table was in excess of 5 feet (1.5 m) from the ground surface. This depth, while not ideal would allow a shallow basin (about 2 feet or .6 m deep) to be constructed.

Infiltration tests were also completed at the site. A 10 inch (25.4 cm) diameter well was constructed and the lower portion to the depth of the water table backfilled with bentonite chips. A 4 inch (10.2 cm) well screen was inserted, and the top two feet (.6 m) backfilled with concrete. The results of the percolation tests indicate infiltration rates of  $6.2(10^{-4})$  cm/s or  $2.0(10^{-5})$  ft/s, which are within the criteria established for infiltration of  $1.94(10^{-4})$  cm/s or  $6.25(10^{-6})$  ft/s respectively.

### ***5.2.2 I-5 at Manchester Ave. (East)***

A 10-inch (25.4 cm) core hole was drilled in the area of the lower one-third of the site for the purposed of infiltration testing. Fine to medium grey sand was encountered at about 5 feet (1.5 m) bgs. Groundwater was encountered at about 8 feet (2.4 m) bgs. The lower portion of the hole was backfilled with bentonite chips and a 4" well screen was installed and backfilled with permeable material. The top 5 feet (1.5 m) of the test hole was backfilled with concrete and the well was presaturated with potable water. About four days after completion of the test well, and prior to initiation of the in-hole permeability test, the groundwater level was re-measured. The groundwater level had risen to 2.75 feet (.8 m) bgs. Since this value was higher than the estimated floor elevation of the basin, further geotechnical investigation was discontinued.

### **5.2.3 I-5 at Manchester Ave. (West)**

A 10-inch (25.4 cm) core hole was drilled in the area of the lower one-third of the site for the purposed of infiltration testing. Fine to medium grey sand was encountered at about 5 feet (1.5 m) bgs. Groundwater was encountered at about 7 feet (2.1 m) bgs. The lower portion of the hole was backfilled with bentonite chips and a 4" well screen was installed and backfilled with permeable material. The top 5 feet (1.5 m) of the test hole was backfilled with concrete and the well was presaturated with potable water. About four days after completion of the test well, and prior to initiation of the in-hole permeability test, the groundwater level was re-measured. The groundwater level had risen to 3.75 (1.1 m) feet bgs. Since this value was higher than the estimated floor elevation of the basin, further geotechnical investigation was discontinued.

### **5.2.4 SR 78 at I-15**

The proposed site includes an existing excavation (basin) where the existing site storm drain enters and exits under adjacent roadway ramps. The geotechnical investigation was completed on the existing basin side slope, about 7 feet (2.1 m) above the basin floor. Clays were encountered below the fill material at the level of the existing basin floor (about 6 feet or 1.8 m), bedrock was encountered at about 30 feet (9.1 m).

A wellscreen was installed beginning about 4 feet (1.2 m) below the grade of the existing basin, and continuing another 10 feet (3.0 m) deep. The wellscreen above and below the test zone was sealed with benonite chips and pre-saturated.

The in-drill hole permeability tests were completed about 3 days later once the ground had become saturated. An average in-drill hole permeability rate of  $7.5(10^{-7})$ ft/s (0.03 in/hr) or  $2.5(10^{-5})$ cm/s was determined. This rate is substantially less than the minimum established value of  $6.25(10^{-6})$ ft/s (0.3 in/hr). Consequently, this site was eliminated from further consideration.

## **5.3 Conclusions and Site Description**

The only viable infiltration basin site of those investigated is La Costa Blvd. west. The infiltration rate at this location is  $6.2(10^{-4})$  cm/s. The area can be accessed from the I-5 southbound offramp, and adequate space is available to construct a guardrail and locate a 30-foot clear recovery zone, as required by Caltrans for safety reasons. The site receives up to about 3 acres (1.2 ha) of drainage area from I-5 and the southbound offramp at La Costa Blvd. Drainage flows from the I-5 Southbound to an overside drain drainage inlet. Runoff from the offramp also flow through the same overside drain. To comply with requirements of the San Diego Consent Decree, it is proposed that two extended detention basins be substituted for two infiltration basins (see Chapter 2 of this report).

The general site vicinity can be seen in *Figure 5-1*. The proposed site location for the infiltration basin is in the center of the grassy area shown in *Figure 5-2*. The distance from edge-of-infiltration basin to the edge of the Lagoon will be approximately 100 feet (30.5 m). Discharge from the basin at high flows will exit into a new lined open channel to the shore of Bataquitos Lagoon. This location was selected because of its geotechnical characteristics and proximity to a sensitive receiving water, where existing roadway runoff discharges to the Lagoon with little buffer area. In addition, sufficient existing right-of-way is available for the basin.



*Figure 5-1, General Site Vicinity*



*Figure 5-2, Basin Location*

The receiving water for this site is immediately adjacent to the ***Bataquitos Lagoon*** and in the target watershed. The distance from edge-of-infiltration basin to the edge of the Lagoon will be approximately 100 feet (30.5 m). Existing roadway runoff discharges directly to the Lagoon via a short storm drain system.

Bataquitos Lagoon was not listed as a 303(d) waterbody on the previous evaluation cycle, but has been impaired in the past relative to eutrophication (nutrients and sediment). The Bataquitos Lagoon was recently dredged and restored in an expansion mitigation program by the Port of Los Angeles. Restoration has greatly enhanced the lagoon water quality; however, sediment and nutrients continue to be constituents of concern for this waterbody. Endangered species in the lagoon area include the Least Tern.

## **6.0 Wet Basin**

As part of the District 11 Pilot Retrofit Program, RBF has reviewed Caltrans freeways and highways for the purpose of selecting one site to evaluate the feasibility and effectiveness of installing a wet basin.

A wet basin is an excavated depression, which holds a permanent pool of water in the basin during and between storm events. The continuous availability of a water source provided by the basin allows for the establishment of aquatic vegetation around its perimeter. The vegetation enhances constituent removal. Wet basins remove both soluble and small particulate constituents through settling processes and biological uptake. Constituent removal in wet basins occurs primarily during quiescent periods between storms. The permanent pool provided by wet basins is useful because it reduces energy from inflow, and develops a biological filter that can remove soluble nutrients and metals.

The term 'wet basin' is fairly broad and encompasses wet ponds, constructed wetlands, among other configurations. The type of basin and design details for the pilot installation will be defined in the design phase of the project.

Wet basin outlets may require energy dissipaters and downstream receiving channel stabilization. These actions would mitigate scouring in the downstream channel that could otherwise produce sediment in the receiving waters.

Stormwater runoff constituent removal efficiencies, in addition to operation and maintenance, will be monitored for a two-year period.

Wet basins may be feasible for highways in residential or commercial areas with a combined drainage area greater than 20 acres (8 ha), possessing a large fraction of off-site drainage and a dependable water source. Alternately, they may be viable for smaller watersheds where a perennial water source, such as the water table, may be used. They would typically not be used in drainage areas less than 10 ac (4 ha) if no source of water is available other than urban runoff. If the wet basin is not properly maintained or the basin becomes stagnant, floating debris, scum, algal blooms, unpleasant odors, and insects may appear. Sediment removal is usually necessary after the basin has been functional for about 10 years.

## **6.1 Wet Basin Characteristics**

The basic elements of a wet basin are summarized below. A stabilized inlet prevents erosion at the entrance to the basin. It may be necessary to install energy dissipaters. The permanent pool of water is usually maintained at a depth between 3 and 8 feet (1.0 and 2.5 m). The shape of the pool can help improve the performance of the basin. Maximizing the distance between the inlet and the outlet provides more time for mixing of the new runoff with the basin water and settling of constituents. Overflow from the basin is released through outlet structures to discharge flows at various peak elevations and peak flow rates. The outfall channel should be protected to prevent erosion from occurring downstream of the outlet.

In a highway context, wet basins are typically associated with a site having significant off-site drainage and year round base flow. Wet basins may fit a highway-landscaping plan in sites above culverts where the highway embankment doubles as a dam and the culvert entrance is fitted with a riser. This requires a minimum amount of right-of-way area. However, it is undesirable to have a large amount of water against the highway embankment, for maintenance and embankment integrity purposes.

## **6.2 Site Selection Process**

The site selection process began with a reconnaissance of Caltrans highways and freeways in San Diego County, District 11. Site evaluations included an initial feasibility investigation, followed by a more detailed site investigation.

Feasibility investigations to determine areas owned by Caltrans along freeway and highway interchanges, and on- and off-ramps were first performed. The feasibility investigation included review of topographic mapping to identify potential sites. Viable candidate sites from the feasibility phase were further investigated to determine available area, and estimated tributary watershed through a field review process. Adequacy of the site was determined by estimating the required basin surface area (a function of tributary area) and including safety setback limits required by Caltrans. If these criteria were satisfied, further site investigation was considered. (Field notes can be found in Appendix B.)

Safety concerns dictate several siting criteria, including the reservation of a 30 foot clear recovery zone (for motorist safety) around the perimeter of the basin. In addition, the basin must be protected by guard rail behind the edge of shoulder, and a second 'k'-rail at the periphery of the 30 foot clear zone. Other criteria, such as maintenance access and suitable site topography must also be satisfied. A section of the California Highway Design Manual and a Memorandum from Caltrans District 7 document the basis for the safety setback and are contained in Appendix D.

Further investigation consisted of a preliminary geotechnical review and obtaining grading and drainage plans from Caltrans. This information was then evaluated using a weighted decision matrix. Each site was evaluated and compared with respect to several different criteria or characteristic categories. Most criteria were given a value, or weight (1-10) with respect to its importance and relevance to the site selection process. The rating system for scoring sites on each criterion is located in Appendix C.

The characteristics determined to be important for siting wet basins are the following:

- target watershed (1-10);
- sufficient area for siting the wet basin (1-10);
- location away from building foundations and highway pavement (1-10);
- proximity to receiving waters (1-10); and
- maintenance access (1-10).

The sites investigated within District 11 are given in Table 6-1. The three best sites indicated in bold face type in Table 6-1 were the subject of a detailed geotechnical investigation to determine the depth to the water table at each site, as no other perennial source of water is available.

**Table 6-1**  
**Wet Basin Decision Matrix**

Site	Target Watershed	Space Available	Proximity to Structures	Maintenance Access	Proximity to Rec. Water	Total
<i>Weight</i>	7	10	10	8	10	
I-5 and La Costa Blvd.(East)	10	5	7	7	8	326
<b>I-5 and La Costa Blvd.(West)</b>	<b>10</b>	<b>9</b>	<b>7</b>	<b>7</b>	<b>10</b>	<b>386</b>
I-5/SR 56 Interchange	5	4	7	9	9	307
I-5/Manchester Ave. (East)	10	7	7	9	8	362
<b>I-5/Manchester Ave. (West)</b>	<b>10</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>8</b>	<b>344</b>
I-5/San Dieguito River	5	8	6	2	8	271
SR 78 at Melrose (eastbound)	10	4	7	6	5	278
<b>SR78/I-15</b>	<b>10</b>	<b>10</b>	<b>9</b>	<b>10</b>	<b>5</b>	<b>390</b>

The decision matrix indicates that both the I-5/San Dieguito River and the SR 78 at Melrose (eastbound) are poor sites for a wet basin, being the only two sites to score under 300 points in the “total” column of the matrix. The I-5 and La Costa Blvd. (east) site is infeasible due to limited space and a significant amount of non-Caltrans inflow. Lastly, the terrain at the I-5/SR 56 Interchange site makes it very difficult to get a drilling rig to the site to test for the location of the water table level. However, since the site is constructed on fill, it was estimated that the permanent groundwater table was too far below the existing ground elevation to make the site viable for a wet basin. While both the Manchester east and west sites were determined to be suited for wet basin siting, the Manchester east site was selected for an extended detention basin due to its larger size. The three best sites are indicated in bold face type in Table 6-1 and were the subject of further investigation.

### **6.3 Discussion of Geotechnical Investigation**

Borings were drilled at selected sites to determine the location of the seasonal high water table relative to the existing grade. Sites where the groundwater table was about six feet (1.8 m) below ground surface (bgs) were considered viable for locating a wet basin.

#### ***6.3.1 I-5 at La Costa Blvd. (West)***

Two borings about 50 feet (15.2 m) apart were drilled in the vicinity of the proposed basin area. The groundwater elevation was measured at 8 feet (2.4 m) bgs and 9 (2.7 m) feet bgs for each of the test holes respectively. The depth to the water table was re-measured about 1 week later at high tide to ensure that local groundwater fluctuations did not significantly alter the depth to the free water surface. The second measurement indicated that the depth to the water table was in excess of 5 feet (1.5 m) from the ground surface. This site is considered marginal for siting a wet basin due to the depth to the permanent ground water table.

#### ***6.3.2 I-5 at Manchester Ave. (West)***

A 10-inch (25.4 cm) core hole was drilled in the area of the lower one-third of the site for the purpose of measuring the depth to the groundwater table. Fine to medium gray sand was encountered at about 5 feet (1.5 m) bgs. Groundwater was encountered at about 7 feet (2.1 m) bgs. Four days later, the groundwater level was re-measured. The groundwater level had risen to 3.75 feet (1.1 m) bgs. Again, the groundwater in this area appears to be artesian, due to a confining layer located near the ground surface. This site is considered feasible for a wet basin.

### 6.3.3 SR 78 at I-15

An exploration well was drilled near the existing basin area. The first eight feet (2.4 m) of drilling encountered large gravel to boulder size fill material with a clayey to silty sand matrix. Below the fill, natural material encountered consisted of a moist to wet dark gray clayey to silty fine to coarse-grained sand. At 25 feet (7.6 m), weathered granitic rock was encountered. Ground water and fresh granitic rock were not encountered until 30 feet (9.1 m) bgs. This site is not suitable for a wet basin due to the depth to the permanent groundwater table.

## 6.4 Site Description

### *I-5 at Manchester Avenue (West)*

The proposed basin location is within the area created by the southbound offramp from I-5 at Manchester Avenue. The site slopes to the southeast at from 5 to 10 % and toward the San Elijo Lagoon. Drainage tributary to the site is from the Manchester offramp and the southbound freeway lanes. About 2 acres (.81 ha) of impervious surface are tributary to the site. The basin will be constructed in the loop area, discharging to an existing cross culvert that carries the stormwater under Manchester Avenue and discharges directly to the San Elijo Lagoon. Adequate space is available to construct a guardrail and locate a 30-foot (9.1 m) clear recovery zone, as required by Caltrans for safety reasons. *Figure 6-1* shows the site location, and *6-2* indicates the freeway inlet to the basin.



*Figure 6-1(Site location)*



*Figure 6-2 (Freeway inlet)*

The site is within the target watershed and is across Manchester Avenue from the ***San Elijo Lagoon***. Drainage tributary to the lagoon is from the Manchester offramp and primarily the southbound freeway lanes. Discharge to the San Elijo Lagoon is through to an existing cross culvert that carries the storm water under Manchester Avenue. The storm drain path is approximately 50 feet in length.

The San Elijo Lagoon is a State Ecological Preserve. It is habitat for rare and endangered species and has been the subject of several scientific studies. San Elijo Lagoon has been

directly impacted by the increased urbanization of northern San Diego County, resulting in a number of ecological problems including excessive freshwater flows, increased sedimentation, eutrophication and fecal contamination. Metals and organic pollutants have accumulated in the sediments. Closure of the lagoon mouth of the bay has lead to a variety of ecological problems including low dissolved oxygen and low salinity within the lagoon. Beneficial uses of the coastal lagoon include recreation, estuarine habitat, wildlife habitat, biological habitat of special significance, rare or threatened species habitat, and spawning habitat.



## **7.0 Oil Water Separator**

As part of the District 11 Pilot Retrofit Program, RBF is selecting a Caltrans Maintenance station for the purpose of evaluating the feasibility of installing an Oil/Water Separator.

### **7.1 Site Selection Process**

The primary maintenance sites in District 11 were investigated by field review. Site investigations included a general tour of the grounds, photos, and observations relative to current housekeeping practices, yard activities, and existing structural BMP controls. Detailed field notes for each of the sites visited are provided in Appendix B.

Field information was evaluated using a weighted decision matrix process. Each site was evaluated and compared with respect to facility acreage and eight specific criteria and characteristic weighting categories. Each criteria or characteristic category was given a value, or weight (1-10) with respect to its importance and relevance to the site selection process. (The rating system for scoring sites on each criterion is located in Appendix C.)

Since this analysis is for the Oil/Water Separator portion of the retrofit pilot program, the characteristics selected for weighting were the following: location within the target watershed, presence of heavy equipment, method of asphalt containment, quality of oil waste storage, type of runoff flow paths (for sampling), site exposure to rain, type of on-site drainage, accessibility of site, and safety with respect to vehicular traffic.

The site characteristic values, are assigned for each category at each site. For example, the presence of heavy vehicles in uncovered parking areas receives the highest value of 10. Conversely, if a site does not display a certain characteristic, it will yield a low, or no score. Each site is then rated by developing a composite score, representing all of the individual characteristic categories, as shown in *Table 7-1*.

The maintenance stations investigated within District 11 were as follows:

- Carlsbad
- Chula Vista
- **Escondido**
- Kearny Mesa
- Santee

The site with the highest composite score within the target watershed was chosen and is denoted in bold and further described in the following paragraphs.

These five stations were selected for field investigation after review and consideration of an October 29, 1997 list of twenty-one maintenance stations in District 11. Eight of these facilities are outside of the urbanized area, and were eliminated from consideration.

Three of the maintenance stations within the urbanized area are listed as “not in use” and were also eliminated from consideration. Of the ten operating facilities within the urbanized area, three are landscape maintenance stations without the heavy equipment used by road crews, one is a small bridge crew maintenance station under the Coronado



Bridge and one is a temporary storage yard. The remaining five maintenance stations within the urbanized areas with road crews were visited to select a candidate facility for monitoring. These facilities are also the largest maintenance stations within the urbanized portion of District 11.

The Escondido site was also selected considering its relative proximity to sensitive receiving waters. The Escondido Maintenance Station is tributary to Escondido Creek, a major stream course in North County and the Carlsbad Hydrologic Unit. Escondido Creek flows through San Elijo Canyon downstream of the site and discharges in to the San Elijo Lagoon. The San Elijo Canyon passes through a rural undeveloped watershed with a designated beneficial use that includes wildlife habitat. Escondido Creek is largely natural (unimproved) for the entire reach from the site to the San Elijo Lagoon. The San Elijo Lagoon is an ecological preserve providing marine habitat for rare, threatened and endangered species.



**Table 7-1: Oil/Water Separator Selection Matrix  
for Stormwater Monitoring Program**

<i>Weight</i> <b>Site Name</b>	<i>7</i> <b>Target Watershed</b>	<i>10</i> <b>Heavy Vehicles</b>	<i>6</i> <b>Asphalt Contnmt.</b>	<i>7</i> <b>Oil Waste Storage</b>	<i>6</i> <b>Flow path</b>	<i>7</i> <b>Site Exposure</b>	<i>7</i> <b>Onsite Drainage</b>	<i>5</i> <b>Access</b>	<i>5</i> <b>Traffic Safety</b>	<b>Total Weight Value</b>
Carlsbad	10	8	2	2	6	10	5	10	7	402
Chula Vista	0	7	2	2	3	10	5	6	8	289
<b>Escondido</b>	<b>10</b>	<b>8</b>	<b>5</b>	<b>6</b>	<b>8</b>	<b>10</b>	<b>9</b>	<b>7</b>	<b>8</b>	<b>478</b>
Kearny Mesa	5	10	7	6	8	10	9	5	7	460
Santee	0	8	2	2	6	10	7	2	6	301

*Note: All scores range from 0-10.*

*L = Landscape maintenance yard only.*

*Kearny Mesa is out of our target watershed.*

The weighted decision matrix process indicates that the Kearny Mesa and Escondido facilities should receive the highest priority consideration among the District 11 maintenance stations as the final candidate site for the installation of an oil/water separator.

The Kearny Mesa maintenance yard is not located within the proposed Caltrans's target watershed. In addition, the Escondido site is more typical of the other District maintenance facilities than is the Kearny Mesa facility. Kearny Mesa is three times larger than any other maintenance facility in the District. It is the Operations Center for the District and houses the Maintenance Department Regional Office. As such, it has special crews not typically found at other facilities. The site contains a much larger wash rack than is typical at other facilities, a second smaller outdoor wash rack, and an enclosed wash rack, which is for hot water and steam cleaning. This enclosed wash bay is equipped with a sump and a clarifier. For these reasons, RBF considers Kearny Mesa to be atypical and has selected Escondido as the recommended candidate site for possible installation of an oil/water separator. It is anticipated that the Kearny Mesa facility may be used as a pilot site for the Media Filter portion of the retrofit investigation.

## **7.2 Matrix Selection**

The Escondido maintenance station is located at 1780 West Mission Avenue just off the Nordahl Road offramp. The station area is approximately 4.5 acres (8.2 ha). The area is bounded by Mission Avenue, State Route 78, and industrial activity on two sides. The site is equipped with onsite drainage facilities.



**Figure 7-1: Escondido MS**



**Figure 7-2: Heavy Vehicles**

The Escondido station yielded the second highest composite value in the District 11 matrix (see Table 7-1). Escondido contains approximately 15 heavy multi-crew maintenance vehicles and 25 employee vehicles as shown in *Figure 7-2*.

This maintenance station is completely exposed. The site drainage system consists of three drain inlets, one culvert inlet and one curb spillway runoff. The flow patterns for this area consists of mostly curb, swale, and sheet flow.



With respect to sampling, the two best locations would be the curb flow along the western edge of the site prior to the culvert, and the pond discharge in the wash rack area, prior to its discharge to the channel located outside the yard fence. Although these locations only obtain approximately 60% of the total flow of the area, their catchment areas include almost all of the heavy vehicle parking areas.

The safety aspects, with respect to the sampling team, are good. No street or onsite vehicular traffic is anticipated.

### **7.3 Oil/Grease Analysis**

Stormwater runoff from the Escondido maintenance station was sampled during four storm events in the fall/winter of 1997 and analyzed for total concentration of oil and grease. The results indicate that the concentration of oil and grease in the runoff make the use of a commercial coalescing plate oil/water separator device ineffective. Oil/water separators are commonly used to reduce oil and grease to approximately 10 mg/l. Installing such a device, where the initial average concentration of oil and grease is only 9.4 mg/l and the maximum concentration found was 12.0 mg/l, would not significantly further reduce the concentration of free oil and grease in the runoff. The raw sampling data for each of the sampled storms is as follows:

**Table 7-2: Oil/Grease Analysis (mg/L)**

Site Location	2. Sampling Date (in 1997)				
	Nov. 10	Nov. 13	Nov. 26	Dec. 18	Average
Escondido	12.0	4.3	8.2	13.0	9.4

The oil/water separator was eliminated from the proposal. Sand media filter is proposed at Escondido MS (see Chapter 8 of this report). The NRDC concurred with the decision to not use the oil/water separator but to the substitutions of one infiltration trench, a compost filter and a sand filter at different maintenance stations.

## **8.0 Media Filters**

As part of the District 11 Pilot Retrofit Program, RBF has selected four Caltrans maintenance stations and park & ride facilities as sites for the purpose of evaluating the feasibility and effectiveness of installing media filters.

Media Filters are defined as chambers containing filtering media such as sand, compost, or sand/peat layers that discharge to an underdrain system. Media filters are designed primarily to remove sediment, or particulate constituents. Other runoff constituents such as nutrients, heavy metals, oil and grease, and bacteria and viruses may also be reduced. Sand media filters will be used adjacent to water bodies where excessive fertilization is a concern. Compost filters have been shown, in some studies, to release nutrients. Consequently, compost filters may be considered at locations where receiving waters are not in danger of eutrophication.

### **8.1 Site Selection Process**

The process of locating sites for the Pilot Program involved extensive field reviews of the maintenance stations and park & ride facilities in District 11. Since media filters operate using gravity flow, sites must have drain inlets with a sufficient amount of hydraulic head to accommodate the head loss through the filter. Preliminary estimates suggest that a hydraulic head of one meter (~ three feet) or more is sufficient for filter operation (Mike Barrett, personal communication).

The criteria for selection involved not only the site drainage characteristics, but also the proximity to sensitive receiving waters and the site usage. Type of maintenance activities and equipment storage were considered at maintenance stations. Parking volume and presence of bus transfer bays were noted at park & rides. Tributary area and sediment and/or debris accumulation possibilities were also considered.

The site selection process began by meeting with Caltrans officials to request site plans and related information. Caltrans assisted with field investigations of the maintenance stations and park & ride lots including tours of the grounds, photos, and observations of drainage patterns and general housekeeping practices. (Field notes can be found in Appendix B.)

In general, sites were eliminated from further consideration if one or more of the following problems were present:

- Not enough hydraulic head to operate the filter in the site drainage system;
- Lack of proximity to sensitive receiving waters;
- Low onsite vehicular or heavy equipment usage at maintenance stations;
- Low volume of parking at park & rides; and/or
- Severe upstream sedimentation possibilities.

## **8.2 Sites Considered for Selection**

There are twenty-one maintenance stations in District 11. Table 8-2 shows the selected sites and their drainage characteristics. Eight of these facilities are outside of the urbanized area and were eliminated from further consideration. Three of the facilities are not currently in use, and were also eliminated from consideration. Of the ten operating facilities within the urbanized area, three are landscape maintenance stations without the heavy equipment used by road crews, one is a small bridge crew maintenance station, and one is a temporary storage yard. Activities at these stations are limited. The remaining five stations were further reviewed to determine their potential as a BMP site. The Escondido and Carlsbad Stations were initially eliminated from consideration as they were selected for Oil/Water Separator and Infiltration Trench projects respectively. Kearny Mesa was also initially eliminated from consideration as it was selected as an Infiltration Trench project. The remaining two sites, Chula Vista and Santee are outside of both the primary and secondary target watersheds; consequently, they received significantly lower marks in the 'Target Watershed' criteria in the evaluation matrix. The ten operating facilities in the urbanized area are listed in the criteria matrix (Table 8-1).

There are 35 state owned park and ride facilities in District 11. Activity at the park and ride facilities is limited to commuter parking, so the primary evaluation criteria is defined as the presence of an onsite storm drain system, proximity to a sensitive receiving water, location within the target watershed, and volume of traffic to the lot. Those park and ride facilities located in the target watershed are listed in Table 8-1 and ranked according to the indicated criteria. The rating system for scoring sites on each criterion is located in Appendix C.

Maintenance stations might be considered to generate greater amounts of chemical constituents than park and ride facilities. However, park and rides can be subjected to illicit discharge of used motor oil by motorists since park and rides are not supervised lots as are maintenance stations. In addition, older vehicles located at park and rides are more likely to have oil leaks than are newer, regularly maintained light vehicles at Caltrans maintenance stations. Therefore, it is not so surprising that park and rides scored as highly in the decision matrix as did maintenance stations.



**Table 8-1: Site Selection Criteria**

Facility	Vehicles & Heavy Eqt.	Within Target Watershed <sup>1</sup>	Space Available	Proximity to Sensitive Rec. Water	Site Storm Drain	Drainage Pattern	Total
<b>Weight</b>	<i>10</i>	<i>7</i>	<i>6</i>	<i>10</i>	<i>Y or N</i>	<i>8</i>	
<b>Maintenance Stations</b>							
1. Carlsbad (Trench Site)	8	10	4	7	N	na	Na
2. Chula Vista	7	0	4	5	N	5	184
3. Camino Del Rio	5	0	5	6	N	5	180
<b>4. Escondido</b>	<b>6</b>	<b>10</b>	<b>9</b>	<b>5</b>	<b>Y</b>	<b>9</b>	<b>306</b>
5. Imperial	5	0	4	5	N	7	180
<b>6. Kearny Mesa</b>	<b>10</b>	<b>5</b>	<b>8</b>	<b>5</b>	<b>Y</b>	<b>8</b>	<b>297</b>
7. Otay	4	0	5	5	N	3	138
8. Pacific Highway	4	0	5	5	N	7	176
9. Santee	8	0	8	5	Y	7	234
10. Coronado Bridge	2	0	3	7	N	6	156
<b>Park and Rides</b>							
<b>1. La Costa Ave.</b>	<b>6</b>	<b>10</b>	<b>10</b>	<b>9</b>	<b>Y</b>	<b>6</b>	<b>328</b>
<b>2. Highway 78/I-5</b>	<b>9</b>	<b>10</b>	<b>9</b>	<b>7</b>	<b>Y</b>	<b>8</b>	<b>348</b>
3. Carmel Valley Rd.	8	5	4	6	N	5	239
4. Route 78/College Bl.	3	10	3	7	Y	5	228
5. College Blvd. South	4	10	3	7	Y	2	214
6. Birmingham Dr.-I5	4	10	6	6	N	3	224
7. El Norte-15	6	0	6	7	N	5	206

<sup>1</sup>Receives 10 points if within the watershed, 5 points if within the secondary watershed, 0 points if outside either watershed.

After preliminary selection of the sites, RBF met with representatives of Caltrans and NRDC for a site review on November 19<sup>th</sup>, 1997. After office and field review, the sites that best meet the site selection criteria were determined to be the park & rides at the Interstate 5/78 Interchange and on La Costa Avenue. The maintenance stations at Escondido and Kearny Mesa also scored high in the matrix process. Originally, the Escondido maintenance station was proposed as a site for installation of oil/water separator. However, oil and grease levels measured during the four storms in the November and December of 1997 indicated that oil/water separator will not improve water quality of the runoff at this site. The Escondido and Kearny Mesa maintenance stations were both considered for installation of infiltration trenches. Geotechnical evaluation indicated that permeability of the subsoil at these two sites was not suitable for infiltration trench. Two additional media filters are proposed at these sites to fulfill the requirements of the District 11 Consent Decree.

**Table 8-2: Selected Media Filter Locations**

<b>Site Location</b>	<b>Estimated Elevation Drop at inlet in feet (m)</b>	<b>Drain Tributary Area in acres (ha)</b>
3. Escondido	3 (.9)	1 (.40)
Kearny Mesa	3 (.9)	1.5 (.6)
La Costa Avenue	6 (1.8)	2 (.8)
4. Interstate 5/78 Interchange	3 (.9)	½ (.2)

### **8.3 Site Descriptions**

#### ***8.3.1 Escondido Maintenance Station***

The Escondido maintenance station is located at 1780 West Mission Avenue just off the Nordahl Road offramp. The station area is approximately 4.5 acres (1.8 ha). The area is bounded by Mission Avenue, State Route 78, and industrial activity on two sides. The site is equipped with onsite drainage facilities.



Figure 8-1 (Area)



Figure 8-2 ( Vehicles)

Escondido contains approximately 15 heavy multi-crew maintenance vehicles and 25 employee vehicles as shown in *Figure 8-2*.

This maintenance station is completely exposed. The site drainage system consists of three grate inlets, one culvert inlet and one curb spillway runoff. The flow patterns for this area consists of mostly curb, swale, and sheet flow. The Escondido Station has been selected as a candidate site for a sand media filter.

The Escondido MS discharges to **Escondido Creek**. The maintenance station discharges through a municipal storm drain system approximately three miles in length to Escondido Creek. The discharge occurs at the point where Escondido Creek is concrete lined.

Beneficial uses of the creek include municipal and agricultural use, hydropower generation, recreation, and warm, cold and wildlife habitat. Escondido Creek encompasses an extremely large drainage area and is highly urbanized in some locations, and rural in others. Shortly downstream of the lined reach, the Creek reverts to a natural state, and the perennial base flow indicates that the Creek may support a fishery at this location. Since this creek feeds into San Elijo Lagoon.

The San Elijo Lagoon is a State Ecological Preserve. It is habitat for rare and endangered species and has been the subject of several scientific studies. San Elijo Lagoon has been directly impacted by the increased urbanization of northern San Diego County, resulting in a number of ecological problems including excessive freshwater flows, increased sedimentation, eutrophication and fecal contamination. Metals and organic pollutants have accumulated in the sediments. Closure of the lagoon mouth of the bay has lead to a variety of ecological problems including low dissolved oxygen and low salinity within the lagoon. Beneficial uses of the coastal lagoon include recreation, estuarine habitat, wildlife habitat, biological habitat of special significance, rare or threatened species habitat, and spawning habitat.

### 8.3.2 Kearny Mesa Maintenance Station

The Kearny Mesa Maintenance Station is located adjacent to the 805 Freeway at 7179 Opportunity Road in San Diego. The site is bounded by commercial uses to the east, Opportunity Road to the north, and the I-805 freeway to the south and west. Site drainage is divided into two main areas; the easterly portion of the site is tributary to drain inlets and an underground drainage system. The westerly portion of the site is tributary to an overside drain that discharges to a culvert passing under I-805. The proposed media filter would drain the inlets shown in *Figure 8-3* or *Figure 8-4*, depending on the most flexible arrangement relative to maintenance of the unit which will be determined during final design. Site uses include heavy equipment parking, equipment storage such as engine powered generators, vehicle fueling and an equipment washrack.

This is one of two BMPs that was sited in the secondary watershed, the Penasquitos Hydrological Unit. The reason why the secondary watershed was chosen was that all the viable maintenance stations in the target watershed were being utilized for other BMPs. With maintenance stations preferred over park & rides for media filter sites, the Kearny Mesa Station has been selected as a candidate site for a compost filter.



*Figure 8-3 (Kearny Mesa MS)*



*Figure 8-4 (Site Inlet)*

The Kearny Mesa Maintenance Station is tributary, via Caltrans and downstream municipal storm drain systems, to Mission Bay. The tributary watershed is highly urbanized and relatively large. Kearny Mesa is ultimately tributary to Mission Bay, but is sufficiently buffered by distance so as to mitigate potential concern of the discharge of nutrients from the filter.

The Kearny Mesa Maintenance Station is tributary, via Caltrans and downstream municipal storm drain systems, to ***Tecolote Creek*** and ***Mission Bay***. The discharge path

to Mission Bay is sufficiently buffered by a distance of five miles of municipal storm drain system and intermediate reaches of natural creek.

Tecolote Creek is a freshwater stream that provides warm water habitat and vegetation for wildlife. Stormwater runoff samples from Tecolote Creek typically contain elevated levels of nitrogen, total coliform bacteria, and dissolved solids. These contaminants are carried into Mission Bay, a water body that is also impacted by bacterial contamination from dilapidated sewage pipes. Beneficial uses of Mission Bay include recreation, marine and estuarine habitat for wildlife and marine species.

### **8.3.3 La Costa Avenue (east)**

The La Costa Avenue Park & Ride is located just east of Interstate 5 off the La Costa Avenue exit in the City of Carlsbad. The site was estimated by field observation to be 2 acres (.81 ha). The park & ride is located adjacent to the Bataquitos Lagoon. The sand filter is proposed at this site.

The site drainage system consists of one drain inlet located at the north-eastern end of the parking lot. (*Figure 8-6*). The flow pattern consists of curbs that receive sheet flow and direct it to the site inlet. The inlet discharges to the Bataquitos Lagoon.

This park & ride was selected because of its location adjacent to a sensitive receiving water, the **Bataquitos Lagoon**, as well as the inlet's ideal hydraulic characteristics. The elevation drop from the drain to the discharge pipe outlet is approximately two meters. The flow pattern consists of curbs that receive sheet flow and direct it to the site inlet. The inlet discharges directly to the Bataquitos Lagoon. The flow path is approximately 30 feet in length.

Bataquitos Lagoon was not listed as a 303(d) waterbody on the previous evaluation cycle, but has been impaired in the past relative to eutrophication (nutrients and sediment). The Bataquitos Lagoon was recently dredged and restored in an expansion mitigation program by the Port of Los Angeles. Restoration has greatly enhanced the lagoon water quality; however, sediment and nutrients continue to be constituents of concern for this waterbody. Endangered species in the lagoon area include the Least Tern.



*Figure 8-5 (P&R site)*



*Figure 8-6 (Inlet)*

#### **8.3.4 Interstate 5/ 78 Interchange**

The 5/78 Park & Ride is located just off the Interstate 5 freeway at the intersection with the 78 freeway in the city of Carlsbad. The site was estimated by field observation to be approximately half of an acre (.2 ha). The park & ride is located in a residential area, adjacent to the freeway.

The site drainage system consists exclusively of two drain inlets located at the eastern end of the parking lot adjacent to the Interstate 5 right-of-way. The northernmost inlet captures approximately 65 percent of the total runoff, and thus is chosen for sand filter retrofit (*Figure 8-7*).



*Figure 8-7 (P&R lot)*



*Figure 8-8 (Main drain inlet)*

Although this park & ride is relatively small, it was chosen due to its extensive use. During the field review, approximately fifty cars were parked, which filled almost every stall. The flow pattern of this lot consists of a downstream curb structure that captures sheet flow and routes it to one of the two drain inlet structures.



The selected drain inlet has approximately a three foot (.91 m) drop in elevation from the drain to the receiving pipe soffit. From a design perspective, this site contains more than adequate construction and hydraulic characteristics.

The park & ride is located adjacent to the ***Bataquitos Lagoon***. The flow pattern consists of curbs that receive sheet flow and direct it to the site inlet. The inlet discharges directly to the Bataquitos Lagoon. The flow path is approximately 30 feet in length.

Bataquitos Lagoon was not listed as a 303(d) waterbody on the previous evaluation cycle, but has been impaired in the past relative to eutrophication (nutrients and sediment). The Bataquitos Lagoon was recently dredged and restored in an expansion mitigation program by the Port of Los Angeles. Restoration has greatly enhanced the lagoon water quality; however, sediment and nutrients continue to be constituents of concern for this waterbody. Endangered species in the lagoon area include the Least Tern.

# **District 11**

## **Geotechnical Notes**

## PROJECT MEMORANDUM

Robert Bein, William Frost and Associates  
14725 Alton Parkway  
Irvine, CA 92618-2069

Date: 12/29/97  
97-1019B

Attention: Scott Taylor

Subject: **Anticipated Geotechnical Properties at Selected  
Caltrans Maintenance Yards, District 11, California**

Scott:

As requested, we have reviewed the list of Caltrans sites in District 11 for estimated soil or rock type, ground water depth and permeability properties. This data was derived from researching regional geology maps, ground water depth maps and the knowledge of the area only. No reconnaissance, site visits or field exploration were performed unless noted. Since this report is based on in-house research, the data should be used for rough estimates only, and if on site exploration is conducted, the geotechnical properties of each site could differ from the data as noted on the following table.

In general, the north county sites, along the coast, consists of poorly graded non-cemented **sandstones** in the topographic high areas and unconsolidated alluvium sands to silty sands in the low lying valleys, along rivers and lagoons. Coastal south county sites have a thick layer of very dense **conglomerate** with thick beds of sandstone. These sandstones are tight and usually cemented. Below the conglomerates is a thick dense sandstone. Valleys in the southern areas are usually filled with **alluvium** and/or river sands, gravels and cobbles. The east county region is within the **granite** rocks of the southern California batholith. The low lying areas to the east are usually veneered with weathered granite and/or alluvium.

The anticipated soil types and permeability rates for the selected sites are explained in the following section. The anticipated permeability rates are relative from good, fair to poor depending on the site location and soil type.

1. **Alluvium** – This sedimentary deposit should be less indurated than the other soil and rock types found in the low lying valleys, old river canyons and along the edge of lagoons. The alluvium deposits in the coastal areas of north county are usually sandy and derived from local sandstones. In the inland areas of the south county region, alluvium deposits have abundant cobbles and gravels that increase in sand content toward the coast. Alluvium in the east county region consists of sands to cobbles with clay. This material is usually derived from weathered granites.

Permeability rates should be good in the northern coastal areas, good to fair in the southern regions and fair to poor in the eastern regions. If the material is clayey, permeability rates should be poor.

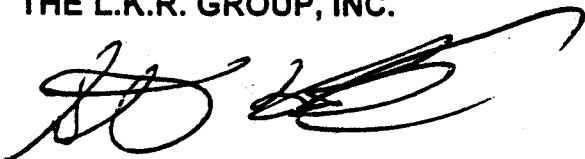
2. **Bedrock** – Ranged from sedimentary sandstones and conglomerates in the north coastal and southern areas to granitic in the east. The sandstones in the north consist of a fine- to medium-grained poorly graded sand. This material is non-cemented and moderately indurated. The conglomerates in the southern regions are common on top of the elevated mesas. This material is usually hard and cemented with a tight grained matrix. Dense and hard sandstone beds are common within and underlying the conglomerate beds. To the east, hard granitic rock is common. The northern sandstones should have good to fair permeability rates. The conglomerates and associated units should have fair to poor and usually poor permeability rates due to the tight and cemented nature of the rock. The granitic material, if unfractured, could have poor permeability properties. The granitic rocks may have a good to fair permeability rate if fractured and if secondary mineralization or sediments are not present infilling the fractures.

General water depths were estimated to be greater (>) or less (<) than the general base level. Base level was set at 50 feet below the ground surface unless the depth was known more accurately.

If you need any additional information, please feel free to contact The LKR Group, Inc. at (310) 320-5100.

Respectfully Submitted,

THE L.K.R. GROUP, INC.

A handwritten signature in black ink, appearing to read 'S. Kolthoff', with a stylized flourish extending from the end.

Steven Kolthoff, Project Geologist

CC: Tom Ryan

# **\*\*ANTICIPATED GEOTECHNICAL PROPERTIES AT SELECTED CALTRANS SITES**

Caltrans Maintenance Stations	District	Thomas Guide Number	Anticipated Soil Type	Anticipated Water Depth (feet)	Anticipated Permeability	Comments
Carlsbas MS	11	1126	Sandstone	> 50	good	Drilled by LKR for this study (non-cemented sandstone)
Chula Vista MS	11	1310	Alluvium	< 20	good/fair	Near the beach (possible beach deposits)
Camino Del Rio MS	11	1269	Alluvium	< 20	good/fair	Near the San Diego River (possible river terrace deposits)
Escondido MS	11	1129	Alluvium	3	n/a	Drilled by LKR for this study (old bog deposits)
Imperial MS	11	1289	Conglomerate	> 50	poor	Stadium Conglomerate and Sandstone (very dense)
Kearney Masa MS	11	1249	Conglomerate	> 50	poor	Stadium Conglomerate and Sandstone (very dense)
Otay MS	11	1350	Conglomerate	> 50	poor	Stadium Conglomerate and Sandstone (very dense)
Pacific Highway MS	11	1268	Alluvium	< 20	good/fair	Near the San Diego River (possible river terrace deposits)
Santee MS	11	1231	Granite/Alluvium	n/a	fair/poor	Granite could be weathered or fractured
Coronado Bridge M	11	1289	Alluvium	< 20	good	Possible beach or near shore deposits

\*\*List Revised 1/15/98

n/a - not applicable

? - queried

> = greater than

< = less than



Robert Bein, William Frost and Associates  
14725 Alton Parkway  
Irvine, CA 92618-2069

December 16, 1997

97-1019

Attention: Scott Taylor

Subject: In-Drill Hole Permeability Tests at  
Selected District 11 Caltrans Sites

Scott:

On December 11 and 12, 1997, The LKR Group (LKR) drilled, or attempted to drill, soil borings at selected Caltrans District 11 sites in San Diego County, California. If the conditions were favorable, 4-inch wells were installed in 10-inch borings to perform in-drill hole permeability tests. The drill sites and boring numbers are listed as follows:

### SITE LOCATIONS

Site Name	Location	City	Boring Numbers
Carlsbad M. S.	6050 Paseo Del Norte	Carlsbad	SD-1
I-5 & Manchester	East and West Side	Encinitas	SD-2 & SD-3
San Dieguito River	East of I-5	San Diego	No public access*
Carmel Valley Road	I-5 and Sorrento V. Road	San Diego	Adverse terrain**
Kearny Mesa M. S.	7179 Opportunity Road	San Diego	SD-4
Escondido M. S.	1780 W. Mission Ave.	Escondido	SD-5
I-15 & SR-78	Interchange	Escondido	SD-6
La Costa	La Costa Ave. & I-5	Leucadia	WW-1 & WW-2

\* No public access to drill site.

\*\* Access was too adverse for conventional drill rig.

#### Carlsbad Maintenance Station

The first site (SD-1) was drilled at the south side of the Carlsbad Maintenance Station paved parking lot. The asphalt pavement encountered was 3-inches thick on top of 6-inches of aggregate base. One inch by 2.5-inch brass ring samples were taken at a depth of 3 feet, and 6-inch by 2.5-inch brass tube samples were taken at depths of 5, 10 and 15 feet below the ground surface. Below the aggregate base a light brown silty

fine- to medium-grained sandstone was encountered to a total depth of 15 feet. No ground water was encountered.

A 4-inch PVC well was installed from the ground surface to 15 feet. From 5 to 15 feet from the surface, a .040-inch wide (040) slot screened section was installed and gravel packed with medium aquarium gravel. The boring above and below the screened section was sealed with medium bentonite chips. A blank section of PVC was installed and sealed with medium bentonite chips in the top 5 feet of the well. The well was pre-saturated with potable water on December 11, 1997.

Since the boring was in sandstone and no ground water was encountered, this site was considered feasible for in-drill hole permeability tests. The in-drill hole permeability tests were performed 4 days after the pre-saturation on December 15, 1997. An average in-drill hole permeability rate of  $2.8 \times 10^{-4}$  feet/s or  $8.7 \times 10^{-4}$  cm/s was determined for the Carlsbad site.

### I-5 and Manchester Interchange

The second and third sites (SD-2 and SD-3) were drilled in the northeast and northwest un-improved areas within the I-5 and Manchester on- off-ramps, north and adjacent to the San Elijo Lagoon. The drill site at SD-2 was on a non-vegetated disturbed area while SD-3 was in a grassy natural area. A 6-inch by 2.5-inch brass tube sample was taken in both borings at 5 feet below the surface. Both sites encountered a saturated light gray, fine- to medium-grained sand at approximately 5 feet or greater below the ground surface. Ground water was encountered in the bore holes at approximately 8 feet at SD-2 and approximately 7 feet at SD-3.

A 4-inch PVC 040 slot screened section was installed gravel packed with medium aquarium gravel from the ground surface to 5 feet. The bottom boring section was sealed with medium bentonite chips and top with concrete. No blank section of PVC was installed. The well was pre-saturated with potable water on December 11, 1997.

After the installation of the wells, the water levels were re-measured 4 days later on December 15, 1997. The ground water level in SD-2 at 9:00 AM was 3.75 feet and in SD-3 at 9:20 AM was 2.75 feet below the ground surface respectfully. Since the ground water levels were shallow, these sites were considered unfeasible for in-drill hole permeability tests.

### San Dieguito River Area

At the San Dieguito River site, there was no public access. This site was not drilled.

### Carmel Valley Road

At the Carmel Valley Road site, the access was too adverse for a conventional drill rig to access. This site was not drilled. The LKR Group, Inc. understands that this site will be drilled at a later time.

### Kearny Mesa Maintenance Station

The Kearny Mesa Maintenance Station site (SD-4) was drilled at the west side of the yard on a paved area adjacent to I-805. The asphalt pavement encountered was 3-inches thick on top of 6-inches of aggregate base. Since the natural material encountered below the base was very hard, no samples were recovered. The natural material, logged from drill cuttings, consisted of a moist to dry reddish brown silty fine- to medium-grained sandstone. This material was encountered to a total depth of 15 feet. No ground water was encountered.

A 4-inch PVC well was installed from the ground surface to 15 feet. From 5 to 15 feet from the surface, a 040 slot screened section was installed and gravel packed with medium aquarium gravel. The boring above and below the screened section was sealed with medium bentonite chips. A blank section of PVC was installed and sealed with medium bentonite chips in the top 5 feet to the surface of the well. The well was pre-saturated with potable water on December 11, 1997.

Since the boring was in sandstone and no ground water was encountered, this site was considered feasible for in-drill hole permeability tests. The in-drill hole permeability tests were performed 4 days after the pre-saturation on December 15, 1997. An average in-drill hole permeability rate of  $7.7 \times 10^{-3}$  feet/s or  $2.4 \times 10^{-4}$  cm/s was determined for the Kearny Mesa site.

### Escondido Maintenance Station

The Escondido Maintenance Station site (SD-5) was located along the central section of the west yard fence on a paved parking lot. The asphalt pavement encountered was 3-inches thick on top of 6-inches of aggregate base. Since the natural material encountered cobbles or large gravels, no samples were recovered. The natural material, logged from drill cuttings, consisted of a moist to wet gray to dark brown silty to clayey fine-grained micaceous sand to gravelly to cobbly sand. This material was encountered to a total depth of 20 feet. Ground water was encountered in the bore hole at approximately 8 feet.

A 4-inch PVC 040 slot screened section was installed and gravel packed with medium aquarium gravel from the ground surface to 5 feet. The boring bottom section was sealed with medium bentonite chips and top with concrete. No blank section of PVC was installed. The well was pre-saturated with potable water on December 12, 1997.

After the installation of the well, the water level was re-measured 3 days after pre-saturation on December 15, 1997. The well was silted up to 3 feet from the surface. This indicates that the water level is approximately 3 feet from the surface. Since the ground water level was shallow, this site was considered unfeasible for in-drill hole permeability tests.

#### I-15 and SR-78 Interchange

At the I-15 and SR-78 interchange between the SR-78 east bound to I-15 north and south off-ramps the site (SD-6) was drilled 6 to 8 feet above a small basin. The first 6 feet of drilling encountered large gravel to boulder size fill material with a clayey to silty sand matrix. Below the fill, natural material encountered consisted of a moist to wet dark gray clayey to silty fine- to coarse-grained sand (disintegrated granite, D G) to a total depth of 30 feet. At 25 feet, weathered granitic rock was encountered. Ground water and fresh granitic rock was encountered at 30 feet.

Since the boring was drilled above the proposed basin level, a 4-inch PVC well was installed from 20 feet to the ground surface. From 20 to 10 feet from the surface, a 040 slot screened section was installed and gravel packed with medium aquarium gravel. The boring above and below the screened section was sealed with medium bentonite chips. A blank section of PVC was installed and sealed with medium bentonite chips in the top 10 feet to the surface of the well. The well was pre-saturated with potable water on December 12, 1997.

Since the boring below 6 feet was in natural material and weathered bedrock and ground water was below the well bottom, this site was considered feasible for in-drill hole permeability tests. The in-drill hole permeability tests were performed 3 days after pre-saturation on December 15, 1997. An average in-drill hole permeability rate of  $7.5 \times 10^{-7}$  feet/s or  $2.4 \times 10^{-5}$  cm/s was determined for this Escondido site.

#### I-5 South La Costa Avenue Off-ramp

On December 12, 1997 in the late afternoon, two shallow borings 50 feet apart were drilled west of the I-5 south La Costa Avenue off-ramp in a grassy natural area south of the Batiquitos Lagoon. During the time of drilling, it was noticed that the tidal level was low in the Batiquitos Lagoon. The borings were excavated to determine approximately where ground water was located and not to determine average in-drill hole permeability rates or to collect samples for laboratory testing.

Boring WW-1 encountered approximately 5 feet of silty to clayey sandy fill. Below the fill, a light gray fine-grained sand with a mild sulfur smell was encountered to 15 feet below the surface. In the boring, the ground water level was measured at approximately 8 feet.

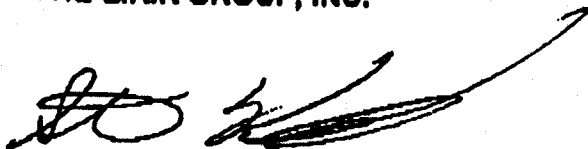
Boring WW-2 was drilled 50 feet to the south of boring WW-1. The upper section encountered approximately 5 feet of silty to clayey sandy fill. Below the fill, a light gray fine-grained sand was encountered to 10 feet below the surface. In the boring, the ground water level was measured at approximately 9 feet.

Both borings were backfilled with medium bentonite chips and allowed to hydrate with natural moisture.

A report will be written to present the final data. At that time, the data will incorporate the laboratory tests and the final field test data.

If you have any questions, please do not hesitate to contact The LKR Group, Inc. at (310) 320-5100.

THE L.K.R GROUP, INC.

A handwritten signature in black ink, appearing to read 'Steven Kolthoff', with a long, sweeping horizontal stroke extending to the right.

Steven Kolthoff, Project Geologist

Cc: Tom Ryan

971019-7



## PROJECT MEMORANDUM

**ROBERT BEIN, WILLIAM FROST AND ASSOCIATES**  
**14725 Alton Parkway**  
**Irvine, CA 92618-2069**

**Date: 12/22/97**  
**97-1019 B**

**Attention: Scott Taylor**

**Subject: Preliminary Laboratory Permeability Rates for the Carlsbad M. S. and Manchester and I-5 Sites District 11 Caltrans Sites**

**Scott:**

Here are preliminary permeability rates and laboratory data for the Carlsbad M.S. and Manchester I-5 east and west sites.

**TABLE OF LABORATORY RESULTS**

Boring Number	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Permeability
SD-1	5'	3.9	104.6	$1.7 \times 10^{-7}$ ft/s
				$5.2 \times 10^{-5}$ cm/s
	10'	6.5	96.2	$1.9 \times 10^{-5}$ ft/s
				$5.8 \times 10^{-5}$ cm/s
	15'	1.6	98.7	$4.9 \times 10^{-4}$ ft/s
				$1.5 \times 10^{-4}$ cm/s
SD-2	5'	16.5	108.4	$1.9 \times 10^{-7}$ ft/s
				$5.9 \times 10^{-5}$ cm/s
SD-3	5'	16.0	110.1	$3.0 \times 10^{-7}$ ft/s
				$9.2 \times 10^{-5}$ cm/s

The average permeability, for the Carlsbad M. S., was  $2.3 \times 10^{-4}$  ft/s, ( $7.1 \times 10^{-5}$  cm/s) for all the laboratory samples tested. The average in-drill hole permeability for this site was  $2.8 \times 10^{-5}$  ft/s ( $8.7 \times 10^{-4}$  cm/s). The laboratory average was slightly slower than the in-drill hole average. The laboratory permeability rates for Manchester & I-5 east and west are as noted on the table for SD-2 and SD-3. No in-drill hole tests were performed.

If you have any questions, please do not hesitate to contact The LKR Group, Inc. at (310) 320-5100.

Respectfully Submitted,

THE L.K.R. GROUP, INC.



## PROJECT MEMORANDUM

**ROBERT BEIN, WILLIAM FROST AND ASSOCIATES**  
**14725 Alton Parkway**  
**Irvine, CA 92618-2069**

**Date: 12/18/97**  
**97-1019**

**Attention: Scott Taylor**

**Subject: Preliminary Laboratory Permeability Rates for  
 Selected District 11 Caltrans Sites**

**Scott:**

Here are preliminary permeability rates and laboratory data for the I-15 / SR-78 site in Escondido.

**TABLE OF LABORATORY RESULTS**

Boring Number	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Permeability
SD-6	10'	12.4	120.4	$4.9 \times 10^{-8}$ ft/s
				$1.5 \times 10^{-5}$ cm/s
	12'	7.8	134.2	$3.1 \times 10^{-8}$ ft/s
				$9.5 \times 10^{-7}$ cm/s
	20'	8.2	117.5	$1.2 \times 10^{-7}$ ft/s
				$3.7 \times 10^{-5}$ cm/s
	25'	14.4	114.0	$7.2 \times 10^{-7}$ ft/s
				$2.2 \times 10^{-5}$ cm/s

The average permeability was  $4.6 \times 10^{-7}$  ft/s, ( $7.0 \times 10^{-5}$  cm/s) for all the samples and  $6.7 \times 10^{-8}$  ft/s, ( $2.0 \times 10^{-5}$  cm/s) for the samples taken within the test interval from 10 to 20 feet. The average in-drill hole permeability for this site was  $7.5 \times 10^{-7}$  ft/s ( $2.4 \times 10^{-5}$  cm/s).

If you have any questions, please do not hesitate to contact The LKR Group, Inc. at (310) 320-5100.

Respectfully Submitted,

THE L.K.R. GROUP, INC.

**District 11**

**Field Notes**

## BMP FIELD INVESTIGATION FORM

Date: \_\_\_\_\_ District: 11 Field Representative: TR

Location: I-5 La Costa Blvd (East)

**Possible BMP Method(s):**

- Infiltration Basin
- Edge of Road
- Wet Pond

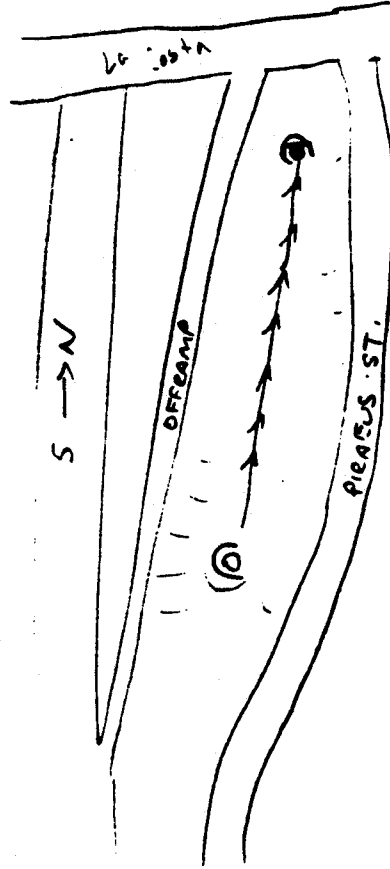
### Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
2	100' x 30'	5% +	N	? Sandy	toilet channel	Inlet - 24" culvert Outlet - 24" culvert	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

**Field Notes:**

- already a wet pond
- Inlet flow comes from ?
- May not be enough room on side of road
- some vegetation may have been wild or protected.



# BMP FIELD INVESTIGATION FORM

Date: \_\_\_\_\_ District: 1 Field Representative: YR

Location: 1-5, La Costa (Wet)

Possible BMP Method(s):

- IB
- FDR
- W13 Pond

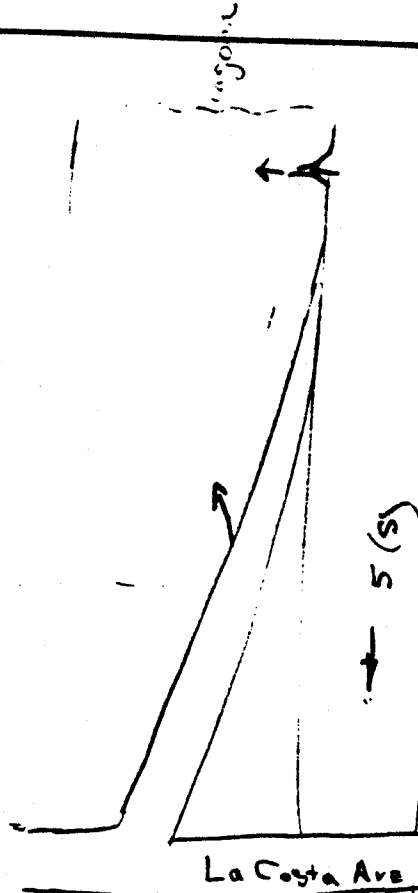
## Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3+	2 acms	2-4%	—	Sandy	—	Sheet + Inlet	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

## Field Notes:

- Current drainage includes gas station + some street flow. Need to reflow.
- Huge basin with good inlet possible.
- Sheet flow out to lagoon
- Possible to connect bridge water.



# BMP FIELD INVESTIGATION FORM

Date:

District: 11

Field Representative: JR

Location: T-5 / SR-56

Possible BMP Method(s):

• Wet Basin

• EDB

## Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3	50' x 100'	—	—	Plage	—	—	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

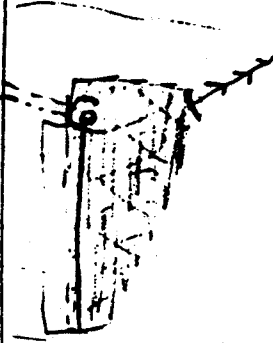
## Field Notes:

- Holding rain water from 5 day before
- Currently takes water from above pass and sends it out via existing overflow channel

• don't look good for inlet

• Need to dig deep

• Can move brim of fill on East side of basin



56 → 5 Inlet

## BMP FIELD INVESTIGATION FORM

<u>Date:</u>	<u>District:</u> 11	<u>Field Representative:</u> TR
<u>Location:</u> J-5 / Inland (1 road)		
<u>Possible BMP Method(s):</u>		

• TB  
• FDS  
• WDS

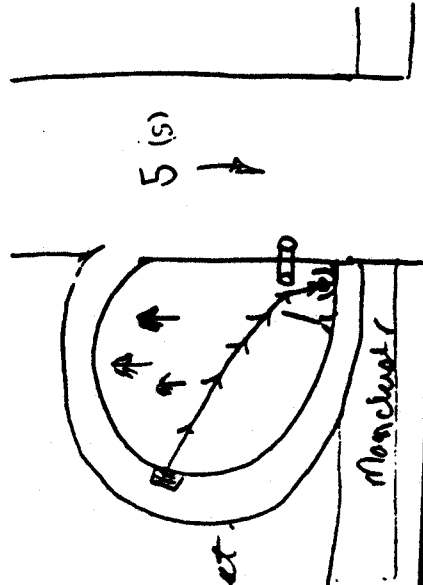
### Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3	$\phi = 100'$	1-3%	—	Sandy?	(inlet) Swale	Culvert inlet	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

### Field Notes:

- Existing swale, grate inlet on off-ramp.
- Drop drain from 5' (S), curb side drain from immediate.
- Culvert outlet directs flow to lagoon across street.
- Several trees.
- Good wet pond.
- WT could be high.



## BMP FIELD INVESTIGATION FORM

Date:

District: 11

Field Representative: TR

Location: I-5, Monrovia West

Possible BMP Method(s):

- IB
- EDB
- WCP

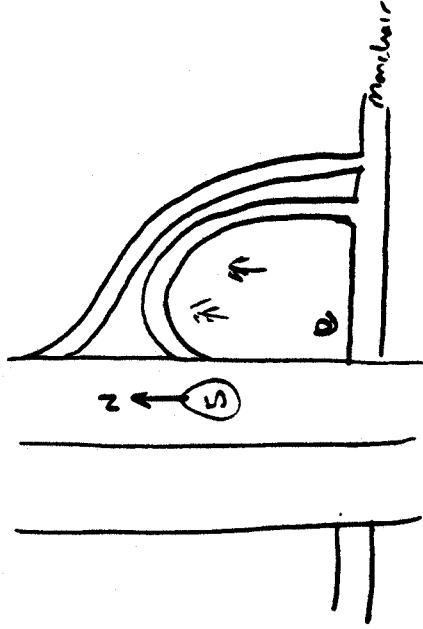
### Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
4	$\phi = 200'$	2-5%	—	Sandy	Direct	exposed	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- It could be high @ low points.
- May need to reroute water from
- ⑤ N under the overpass.
- Good size site for basin
- Lagoon just across street



## BMP FIELD INVESTIGATION FORM

**Date:**

**District:**

11

**Field Representative:**

TE

**Location:**

TS, San Diegoito River

**Possible BMP Method(s):**

- 11b
- NP
- SW
- SD

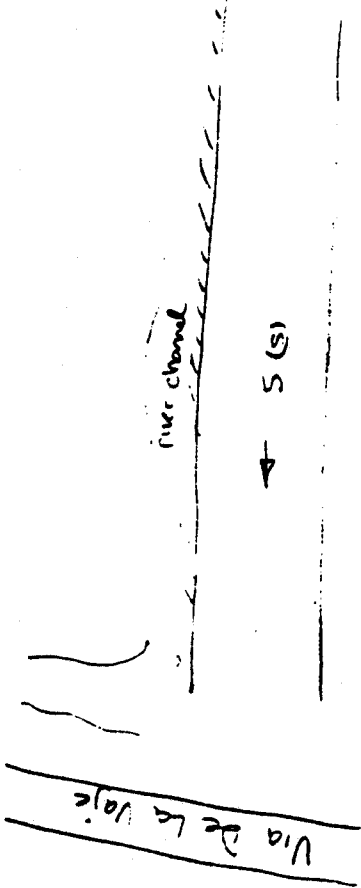
### Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
6	1000' x 50	1-4%	—	Sandy	stabilized	—	—

**Other considerations:** Proximity to water wells, bedrock location, water table depth, distance to foundations.

**Field Notes:**

- Long natural channel
- No maintenance possibilities (Arroyo)
- Flow of rain for my BMP.



5 (s)

## BMP FIELD INVESTIGATION FORM

Date: \_\_\_\_\_ District: 11 Field Representative: TR

Location: CR-78 Melrose

Possible BMP Method(s):

- Swale
- Strip
- Trench
- Swale 1B

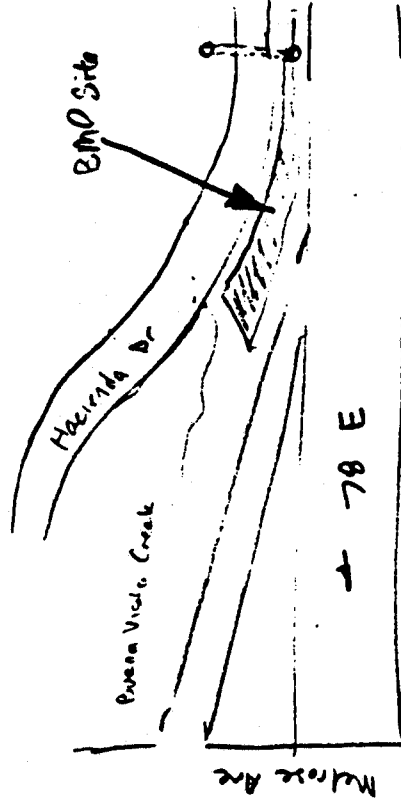
### Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
5	100' x 30'	1-3%	—	Sandy clay	Swale	Grate drain	— 1

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Natural Swale location
- Wide enough at East end for trench or small basin
- Currently has pipe inlet to creek.



## BMP FIELD INVESTIGATION FORM

<u>Date:</u>	<u>District:</u> 11	<u>Field Representative:</u> TR
<u>Location:</u> 878 / I-15		
<u>Possible BMP Method(s):</u>		
• EDB • WP • IB		

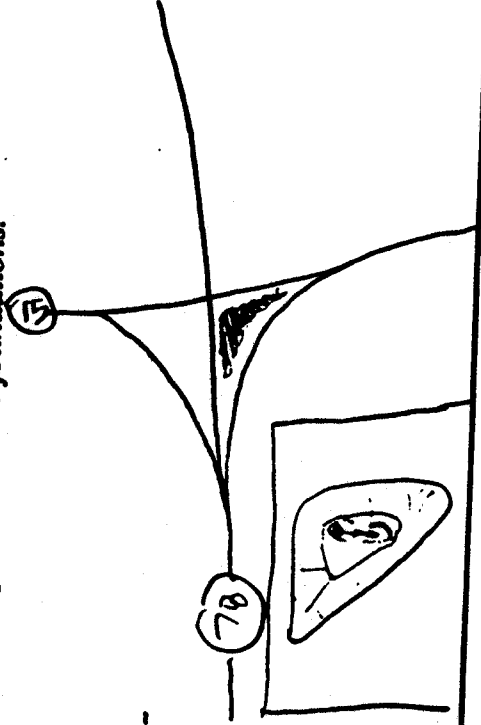
### Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
8+	$\phi = 200'$	—	—	Rejuvenated Gravel to	—	24" culvert	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

### Field Notes:

- Hgt basin, maybe best for IB, EDB.
- Inlet culvert is low, ∴ may need to adjust system
- 20+ ft deep in center basin
- Revers flow from 78(W) from other side of street.



## BMP FIELD INVESTIGATION FORM

Date: \_\_\_\_\_ District: 11 Field Representative: TR  
Location: IS (W) Pine Knob Ave Off ramp  
Possible BMP Method(s): \_\_\_\_\_

### Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
5	50' x 2' 6"	1-5%	—	Heavy Sand	—	Swale	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Swale along side of road = good possible base.

# OIL/WATER SEPARATOR FIELD INVESTIGATION FORM

Date: 10/21/97

District: 11

Field Representative: TR

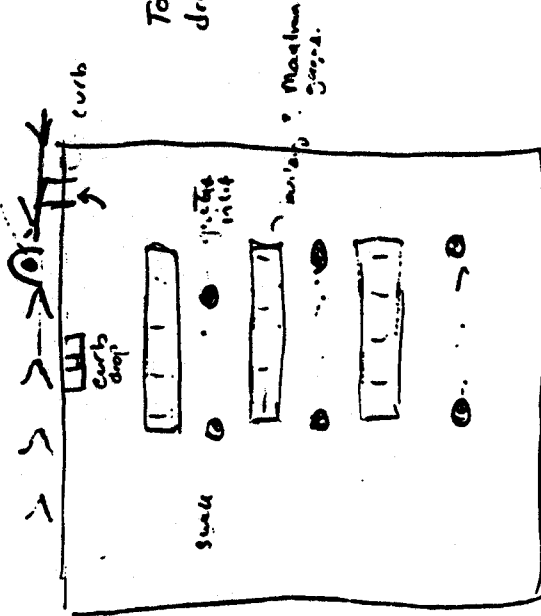
Location: Kearny Mesa MS

## Checklist

Est. # Heavy Vehicles	Asphalt Containment	Oil Waste Storage	Flow Path	Site Exposure	Onsite Drainage	Access	Traffic Safety
50+	Emulsion Sludge	Yes! - Waste barrel storage	Swale - Curb	100%	90% curb = 2 grate = 8	Not great	onside = not great

## Field Notes:

- Operation HQ for Dist. 11.
- A = 16.9 acres
- descent sampling possibilities @ curb inlets
- ~200 employees
- Housekeeping could be improved
- Multi-use yard
- 4 wash racks, incl. ridour stream rack.
- No cold asphalt
- No 2ndary emulsifier center wall
- Room for construction



## BMP FIELD INVESTIGATION FORM

<u>Date:</u>	<u>District:</u> 11	<u>Field Representative:</u> TA
<u>Location:</u> I-5 (N) shoulder (South of San Antonio River Plaza)		
<u>Possible BMP Method(s):</u>		
• Swale		
• Strip		

### Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
10 and	50' x 2 m/b	1-2%	Sandy Soil	—	—	—	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

### Field Notes:

- No berm, good for sheet → strip flow
- Very flat shoulder w/ slight cross slope ~ 5%
- Rain collects in swale.
- Out of Target WS.

## BMP FIELD INVESTIGATION FORM

<u>Date:</u>	<u>District:</u> 11	<u>Field Representative:</u> TR
<u>Location:</u>	I-5 (S) on-ramp to Palomar Airport Rd.	
<u>Possible BMP Method(s):</u>	• curb • 60" p	

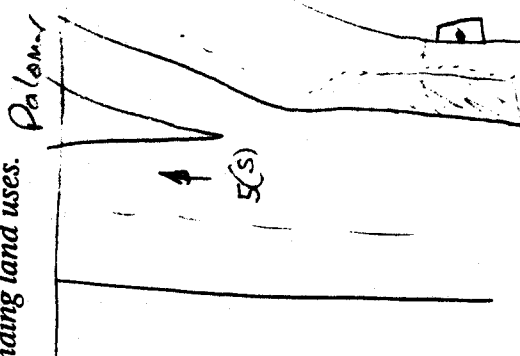
### Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
3	60' x 200'	12%	—	Sand	—	—	—	—

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

### Field Notes:

- Very flat & wide.
- good strip location.
- Curbs outlet is on the other side of the Callens fence on the street.



# BMP FIELD INVESTIGATION FORM

Date:

District:

11

Field Representative:

TR

Location:

SR 78 (E) shoulder before Polaris Ave.

Possible BMP Method(s):

• curbside  
• catchment

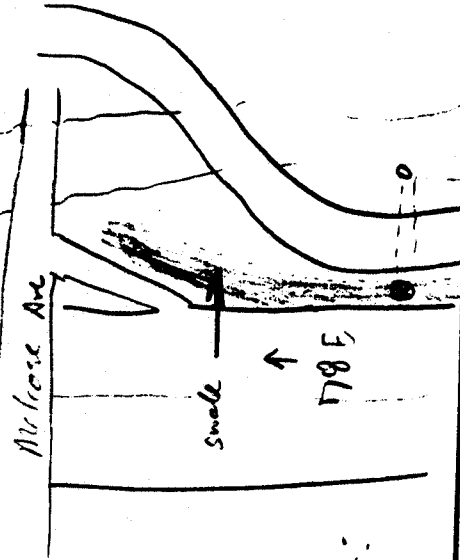
## Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3	25' x 20'	1-3%	—	range	—	—	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- one grate drain 24" open to nearby receiving water
- 200' long pipe under
- 20-60' wide
- can plug drain in, create (only) down swale:



# OIL/WATER SEPARATOR FIELD INVESTIGATION FORM

Date: 10/21/97 District: 11 Field Representative: Tom Ryan

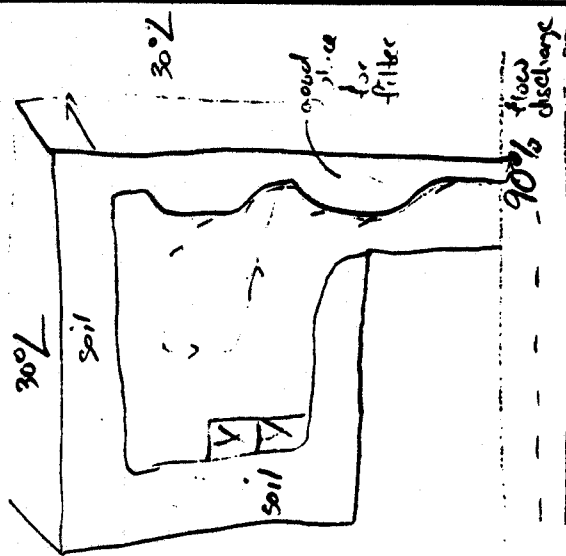
Location: LaeLSBAD 11S

## Checklist

Est. # Heavy Vehicles	Asphalt Containment	Oil Waste Storage	Flow Path	Site Exposure	Onsite Drainage	Access	Traffic Safety
25+	Small empty tanks	no major oil storage	gutter street curbs	100%	No	great	OK

## Field Notes:

- A = 5 acres
- 25 employees pers
- Soil => clayey, cracked asphalt surface
- not much onsite slope
- tire storage exposed
- Urban industrial area
- multi row yard
- covered sand pile



# OIL/WATER SEPARATOR FIELD INVESTIGATION FORM

Date: 10/24/93 District: 11 Field Representative: TR

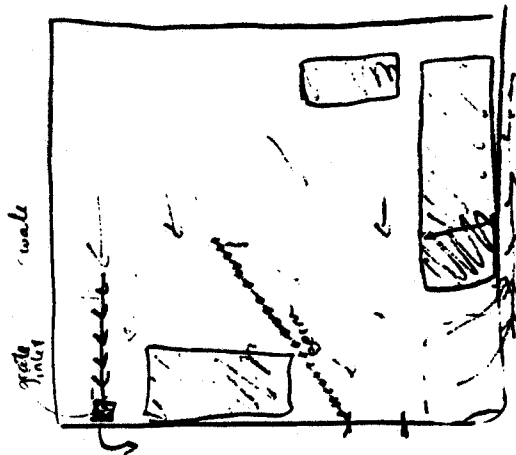
Location: Chula Vista MS

## Checklist

Est. # Heavy Vehicles	Asphalt Containment	Oil Waste Storage	Flow Path	Site Exposure	Onsite Drainage	Access	Traffic Safety
15 +	No heavy containment	Not much	Sheet 80% curb	100%	None, 20% flow to one drain to street curb	OK	OK

## Field Notes:

- A = 4.2 ans
- ~20 employees
- food house keeping (covering oil leaks etc.)
- Mostly sheet flow - not good site to sample
- 70% drainage cut front gate 20% to drain (grate) → street curb
- No asphalt (old)
- toxic waste storage is exposed



# OIL/WATER SEPARATOR FIELD INVESTIGATION FORM

Date: 10/21/97

District: 11

Field Representative: TR

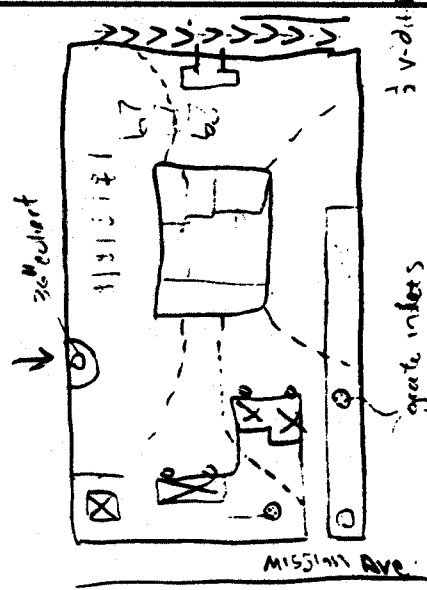
Location: Escobedo MS

## Checklist

Est. # Heavy Vehicles	Asphalt Containment	Oil Waste Storage	Flow Path	Site Exposure	Onsite Drainage	Access	Traffic Safety
15+	emulsion leak	No major probs.	Street - Swale to onsite drain	100%	3 gate inlets 1 culvert inlet	OK	OK

## Field Notes:

- A ≈ 4.5 acres
- ~30 employee cars
- industrial area
- multi crews
- onsite culver takes most site flow (flow from neighbors)
- great sampling possibilities (culvert, back pond)
- tire storage, exposed & not contained



----- = watershed

78 Fur...

# OIL/WATER SEPARATOR FIELD INVESTIGATION FORM

Date: 10/24/97

District: 11

Field Representative: TR

Location: Kearny Mesa MS

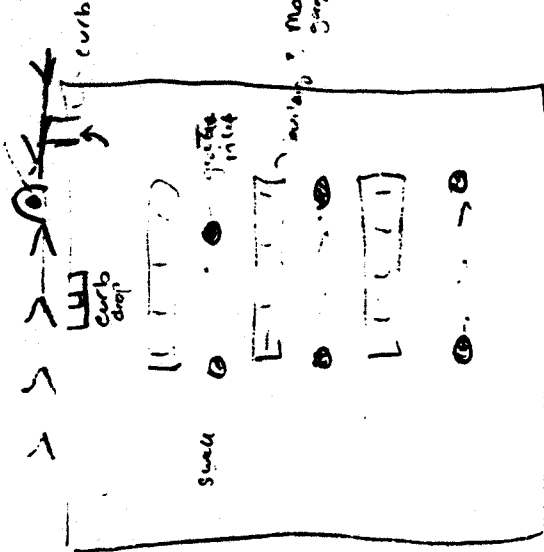
## Checklist

Est. # Heavy Vehicles	Asphalt Containment	Oil Waste Storage	Flow Path	Site Exposure	Onsite Drainage	Access	Traffic Safety
50+	Emulsion Sludge - Vals!	Waste barrel storage	Swale - Curb	100%	90% curb = 2 gate = 8	Not great	onsite = not great

## Field Notes:

Operation HQ for Dist. 11.

- A = 16.9 acres
- descent sampling possibilities @ curb inlet
- ~200 employees
- Housekeeping could be improved
- Multi use yard
- 4 wash racks, incl. ridour stream rack.
- No cold asphalt
- No 2ndary emulsifier containment
- Room for construction



Too large to draw accurately!

# **OIL/WATER SEPARATOR FIELD INVESTIGATION FORM**

**Date:** 10/24/97

**District:** 11

**Field Representative:** TR

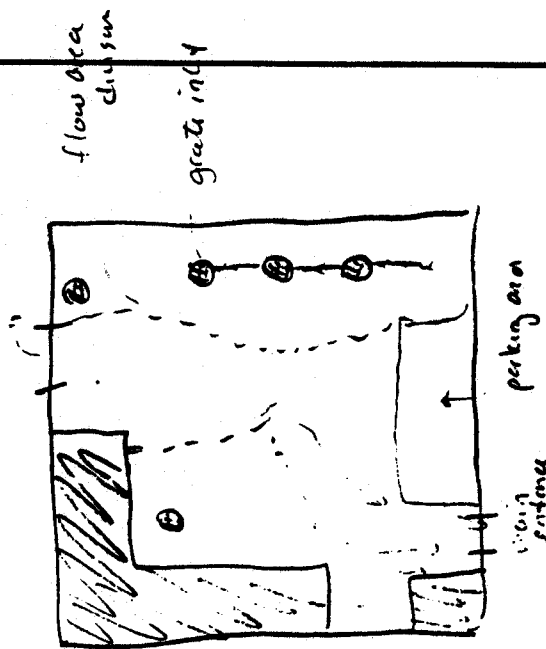
**Location:** SANTEE

## **Checklist**

Est. # Heavy Vehicles	Asphalt Containment	Oil Waste Storage	Flow Path	Site Exposure	Onsite Drainage	Access	Traffic Safety
25 +	Not much	Not much	curb = 40% swale Sleet	100%	5 grate drains 2 curb	Not Good	OK

## **Field Notes:**

- ~40 employees
- New wash racks
- Sampling possibilities, not great
- Clean site.
- Toxic Storage - exposed
- Some curb diversion in flow paths



# **OIL/WATER SEPARATOR FIELD INVESTIGATION FORM**

Date: 10/21/97 District: 11 Field Representative: Tom Ryan

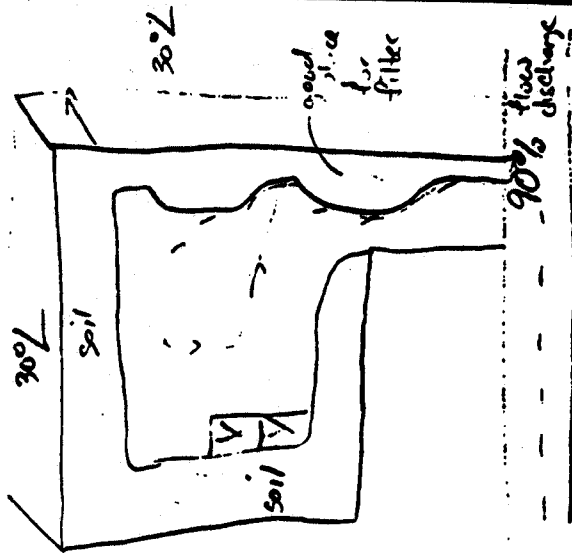
Location: NewsRAD MS

## **Checklist**

Est. # Heavy Vehicles	Asphalt Containment	Oil Waste Storage	Flow Path	Site Exposure	Onsite Drainage	Access	Traffic Safety
25+	Small empty tanks	no major oil storage	gutter, street curb	100%	No	great	OK

## **Field Notes:**

- A = 5 acres
- 25 employees pers
- Soil => clay, cracked asphalt surface
- not much onsite slope
- tire storage exposed
- Urban industrial area
- multi row yard
- covered sand pile



# BMP FIELD INVESTIGATION FORM

Date: 10/24 District: 11 Field Representative: TR

Location: Otay MS

Possible BMP Method(s):

?

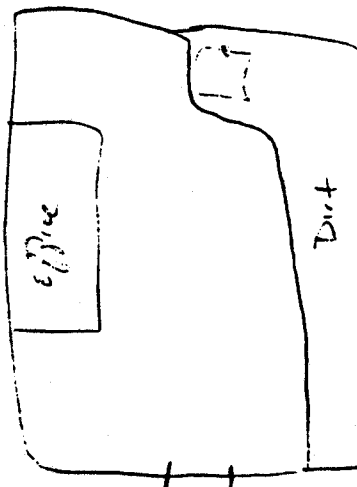
## Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
1 1/2	Y	< 1%	Y	—	Street	—	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

## Field Notes:

- Too far out! Out of Property
- No heavy runoff or disturbance
- Landscape area



## BMP FIELD INVESTIGATION FORM

Date: - District: 11 Field Representative: TR

Location: Locust Ave

Possible BMP Method(s):

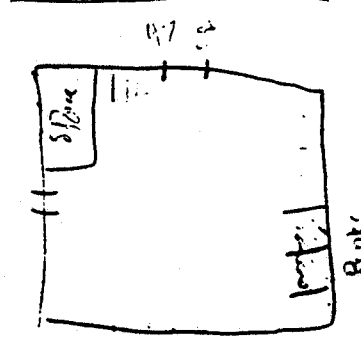
### Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
1	N.	1%	<del>Y</del> N	—	Direct	Direct	

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

### Field Notes:

- material batters
- No large vehicles
- • Landscape paint
- No vehicles, maintenance area



## BMP FIELD INVESTIGATION FORM

Date: - District: 11 Field Representative: TR

Location: Coronado Bridge MS

Possible BMP Method(s):

• Trench

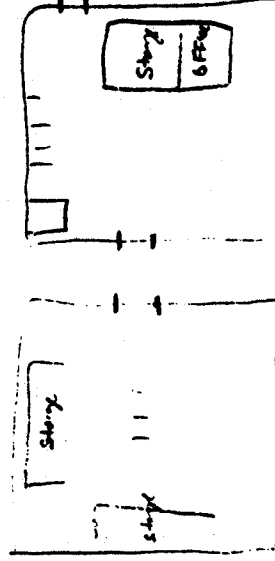
### Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
2	4	1-2%	—	—	Direct	Sub	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

### Field Notes:

- No large rock storage.
- Mostly steel flow in roof drains.
- Landscape Area
- No fueling.
- Don't land stuff to BMP.



# BMP FIELD INVESTIGATION FORM

Date: 10/24/97 District: 11 Field Representative: TR

Location: Camino Del Rio N.B.

Possible BMP Method(s):

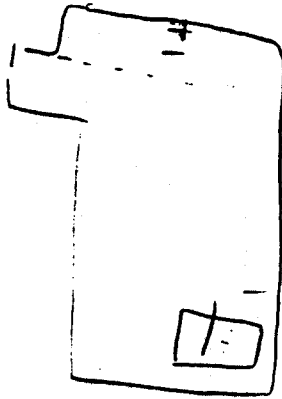
## Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
15	✓	1-2%	Y	—	Stet	None	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

## Field Notes:

- Partially covered.
- Not many large rocks.
- No vehicle wash area, or site.
- No large light traps.
- Landscape area.



## BMP FIELD INVESTIGATION FORM

<u>Date:</u>		<u>District:</u> 11	<u>Field Representative:</u> TQ	
<u>Location:</u> Barnhart Dr. 1/5 P&B				
<u>Possible BMP Method(s):</u>				
• Trench				

Checklist								
Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1	yes	1 1/2	—	—	sheet	Sheet	Yes	100%

**Other considerations:** Proximity to water wells, bedrock location, water table depth, surrounding land uses.

**Field Notes:**

- 20 cons. -> dry. 50% used
- relatively small lot
- runoff = sheet only
- not good place for BMP.

## BMP FIELD INVESTIGATION FORM

		<u>Date:</u>	<u>District:</u> 11	<u>Field Representative:</u> TR				
<u>Location:</u> CR78/1.5 P.R.								
<u>Possible BMP Method(s):</u> • DIF								
Checklist								
Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1	yes	1-4%	—	—	2 water		yes	yes
<u>Other considerations:</u> Proximity to water wells, bedrock location, water table depth, surrounding land uses.								
<u>Field Notes:</u> <ul style="list-style-type: none"> <li>• 2 inlets connected to same storm system.</li> <li>• Outflow seems to be in lagoon.</li> <li>• Good # cars in lot; 95% full = 45 cars.</li> <li>• Good location.</li> </ul>								

## BMP FIELD INVESTIGATION FORM

<u>Date:</u>	<u>District:</u>	<u>Field Representative:</u>
		TR
<u>Location:</u> La Pesta Ar P.R. GFS		
<u>Possible BMP Method(s):</u>		
• MF • Tank		

### Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1/3+	yes	1% - 2%	Y	—	Gravel pit	run	not much!	100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

### Field Notes:

- 2pm weekday → 35 cars
- Abused reserve adjacent to lot.  
↳ receives runoff
- 3' ⊕ head from CB to nearby street.
- 1st a cabinet lot not great location for MF.

## BMP FIELD INVESTIGATION FORM

<u>Date:</u>	<u>District:</u> 11	<u>Field Representative:</u> 7R
<u>Location:</u> Carmel Valley Pt. P.R. I-5		
<u>Possible BMP Method(s):</u>		
• MF		

### Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1/2	not available	1-4%	N	—	Gravel Street	Gravel Street	yes!!	100%

**Other considerations:** Proximity to water wells, bedrock location, water table depth, surrounding land uses.

### Field Notes:

- 3pm weekday => 200 cars
- flow runs directly out driveway to street
- possible MIF site, but must construct as first.

## **District 11**

### **Criteria Rating System**

## **Appendix C: Criteria Rating System, District 11**

*For the purposes of this study, the site selection criteria are defined as follows for each retrofit pilot program:*

### **Extended Detention Basins (Chapter 2)**

**Target Watershed** refers to the primary target watershed for locating and constructing the five retrofit pilot projects. Caltrans has proposed the Carlsbad Hydrologic Unit, as defined by San Diego Regional Water Quality Control Board, as primary watershed. The Penasquitos Hydrologic Unit was considered as a first alternative or secondary watershed for locating the remaining pilot projects. If detailed site investigation of Caltrans right-of-way within the primary target watershed proved that no adequate sites for any of the five pilot projects could be found, some of the projects were located in other watersheds. A site that scores a 10 is located in the target watershed. A site in the secondary watershed scored a 5. A site located in neither watersheds received a score of 0.

**Space Available** includes both the space available to construct the BMP within safety and operational constraints and vehicle access for monitoring the site. A site that scored a 10 would have ample space for construction and monitoring of the BMP including additional space for a safety buffer area (clear zone). A site with a low score would have no or very little space to construct and/or monitor the BMP.

**Proximity to Structures** is the distance from the extended detention basin site to buildings, edge of pavement, or footings of bridges abutments or columns. A site that rated a 10 would not be near any structures. A site that received a low score would be less than 10 feet from a building, less than 20 feet for the edge of roadway paving, or less than 100 feet from footings for bridge abutments or columns.

**Proximity to Receiving Waters** refers to the distance between BMP sites and receiving waters. A score of "10" refers to drainage to a sensitive receiving water. A "0" refers to a site that has a long flow path before draining to receiving waters.

**Site Stormdrain Configuration** refers to the arrangement of inlets, outlets, and conveyance routes. These may influence the design of the extended detention basin. The optimal drain inlet/outlet structure is an in-line system where the inlet and outlet are located at opposite ends of the basin. A generally longer flow length between the inlet and the outlet will provide the opportunity for a greater constituent removal capacity. A score of 10 indicates a long flow length and an in-line drain system. A low score indicates poor drainage configuration.

**Maintenance Access** refers to the ability for maintenance workers and vehicles to enter the site, perform necessary maintenance, and exit the site with little safety hazard. This criterion is especially important to extended detention basins because the outlet may need to be regularly cleared of debris and sediment. A score of 10 means that the site provides safe and good access for maintenance off of public right-of-way and that all

weather access roads can be constructed to the basin at grades compatible with heavy equipment. A low score refers to inadequate access for maintenance work.

### **Infiltration Trench (Chapter 3)**

**Type of Activities** include the type of maintenance activities and equipment storage at a maintenance station or the level of use and the presence of secondary activities at park and ride lots. Sites with extensive vehicle maintenance or equipment storage or other secondary activities, which are more likely to increase pollutant loading, would be scored a 10. A site fewer of these activities (heavy equipment, vehicle fueling, storage of petroleum products) would receive a low score.

**Target Watershed** refers to the primary target watershed for locating and constructing the five retrofit pilot projects. Caltrans has proposed the Carlsbad Hydrologic Unit, as defined by San Diego Regional Water Quality Control Board, as primary watershed. The Penasquitos Hydrologic Unit was considered as a first alternative or secondary watershed for locating the remaining pilot projects. If detailed site investigation of Caltrans right-of-way within the primary target watershed proved that no adequate sites for any of the five pilot projects could be found, some of the projects were located in other watersheds. A site that scores a 10 is located in the target watershed. A site in the secondary watershed scored a 5. A site located in neither watersheds received a score of 0.

**Space Available/Access** includes both the space available to construct the BMP within safety and operational constraints and the maintenance vehicle access for monitoring the site. A site that scored a 10 would have ample space for construction, maintenance and monitoring of the BMP without unduly compromising safety or the operation of the maintenance facility. A site with a low score would not have enough space to construct, maintain, or monitor the BMP.

**Proximity to Structures** is the distance from the trench site to buildings, edge of pavement, or footings of bridges abutments or columns. A site that rated a 10 would not be near any structures. A site that received a low score would be less than 10 feet from a building, less than 20 feet for the edge of roadway paving, or less than 100 feet from footings for bridge abutments or columns.

**Proximity to Receiving Waters** refers to the distance between BMP sites and receiving waters. A score of "10" refers to drainage to a sensitive receiving water. A "0" refers to a site that has a long flow path before draining to receiving waters.

### **Biofiltration Strips and Swales (Chapter 4)**

**Estimated Soil Type** is based on field observations. If a site was located in alluvial soils, the site would score higher in this criterion based on the assumption that higher infiltration rates would predominate. A site with a low score would likely be in an area with terrace deposits and high clay content, or exposed bedrock.

The **Estimated Tributary Area** selection criterion is a function of the amount of tributary watershed area relative to the area available to construct the BMP. A site that scored a 10 would have a tributary area of several acres and enough BMP construction area to safely convey the runoff. The area would allow for maintenance access. A site that scored relatively low would not have enough tributary watershed area or no space to construct the BMP and provide for maintenance and monitoring access.

The **Length** criterion considers whether there is enough room to construct the BMP given the width of the site. This criterion provides for a suitable residence time in the buffer strip or swale (for strips, both gross width and length are an important characteristic, ensuring that sheet flow, rather than concentrated flow occurs across the strip). A site with a score of 10 would have a large length to width ratio, such as 50. A site that scored relatively low would not have enough space to construct the BMP.

**Slope** is the change in elevation compared to the length of the strip or swale. A site scoring a 10 would have a longitudinal slope of about 0.02 percent. A site scoring relatively low would have a slope of over 6 percent with no practical method available to decrease the slope.

**Proximity to Receiving Waters** refers to the distance between BMP sites and receiving waters. A score of "10" refers to drainage to a sensitive receiving water. A "0" refers to a site that has a long flow path before draining to receiving waters.

**Target Watershed** refers to the primary target watershed for locating and constructing the five retrofit pilot projects. Caltrans has proposed the Carlsbad Hydrologic Unit, as defined by San Diego Regional Water Quality Control Board, as primary watershed. The Penasquitos Hydrologic Unit was considered as a first alternative or secondary watershed for locating the remaining pilot projects. If detailed site investigation of Caltrans right-of-way within the primary target watershed proved that no adequate sites for any of the five pilot projects could be found, some of the projects were located in other watersheds. A site that scores a 10 is located in the target watershed. A site in the secondary watershed scored a 5. A site located in neither watersheds received a score of 0.

### **Infiltration Basin (Chapter 5)**

**Estimated Soil** is based on field observations and not on geotechnical testing. If a site was close to a river or appeared to be in an area containing predominately coarse alluvium, the site would score higher in this criterion based on the assumption that the soils would exhibit a higher infiltration rate. A site receiving a low score would likely be in an area with known bedrock or in terrace areas high in clay content.

**Target Watershed** refers to the primary target watershed for locating and constructing the five retrofit pilot projects. Caltrans has proposed the Carlsbad Hydrologic Unit, as defined by San Diego Regional Water Quality Control Board, as primary watershed. The

Penasquitos Hydrologic Unit was considered as a first alternative or secondary watershed for locating the remaining pilot projects. If detailed site investigation of Caltrans right-of-way within the primary target watershed proved that no adequate sites for any of the five pilot projects could be found, some of the projects were located in other watersheds. A site that scores a 10 is located in the target watershed. A site in the secondary watershed scored a 5. A site located in neither watersheds received a score of 0.

**Space Available** includes both the space available to construct the BMP within safety and operational constraints and the vehicle access for monitoring the site. A site that scored a 10 would have ample space for construction, maintenance and monitoring of the BMP including additional space for a safety buffer area (clear zone). A site with a low score would not have enough space to construct, maintain, or monitor the BMP.

**Proximity to Structures** is the distance from the basin site to buildings, edge of pavement, or footings of bridge abutments or columns. A site that rated a 10 would not be near any structures. A site that rated low would be less than about 10 feet from a building, less than 20 feet for the edge of roadway paving, or less than 100 feet from footings for bridge abutments or columns. Further discussion on the siting of infiltration BMPs adjacent to bridge structures is contained in Appendix D.

**Maintenance Access** includes the ability for maintenance workers and vehicles to enter the site, perform necessary maintenance, and exit the site with little safety hazard. This criterion is especially important to infiltration basins because they are maintenance intensive. All weather access with grades compatible with heavy equipment must be feasible for the site to receive a relatively high score.

**Proximity to Receiving Waters** refers to the distance between BMP sites and receiving waters. A score of "10" refers to drainage to a sensitive receiving water. A "0" refers to a site that has a long flow path before draining to receiving waters.

### **Wet Basins (Chapter 6)**

**Target Watershed** refers to the primary target watershed for locating and constructing the five retrofit pilot projects. Caltrans has proposed the Carlsbad Hydrologic Unit, as defined by San Diego Regional Water Quality Control Board, as primary watershed. The Penasquitos Hydrologic Unit was considered as a first alternative or secondary watershed for locating the remaining pilot projects. If detailed site investigation of Caltrans right-of-way within the primary target watershed proved that no adequate sites for any of the five pilot projects could be found, some of the projects were located in other watersheds. A site that scores a 10 is located in the target watershed. A site in the secondary watershed scored a 5. A site located in neither watersheds received a score of 0.

**Space Available** includes both the space available to construct the BMP within safety and operational constraints and the vehicle access for monitoring the site. A site that scored a 10 would have ample space for construction, maintenance and monitoring of the

BMP including additional space for a safety buffer area (clear zone). A site with a low score would not have enough space to construct, maintain, or monitor the BMP.

**Proximity to Structures** is the distance from the basin site to buildings, edge of pavement, or footings of bridge abutments or columns. A site that rated a 10 would not be near any structures. A site that rated low would be less than about 10 feet from a building, less than 20 feet for the edge of roadway paving, or less than 100 feet from footings for bridge abutments or columns. Further discussion on the siting of infiltration BMPs adjacent to bridge structures is contained in Appendix D.

**Maintenance Access** includes the ability for maintenance workers and vehicles to enter the site, perform necessary maintenance, and exit the site with little safety hazard. This criterion is especially important to infiltration basins because they are maintenance intensive. All weather access with grades compatible with heavy equipment must be feasible for the site to receive a relatively high score.

**Proximity to Receiving Waters** refers to the distance between BMP sites and receiving waters. A score of "10" refers to drainage to a sensitive receiving water. A "0" refers to a site that has a long flow path before draining to receiving waters.

#### **Oil Water Separator (Chapter 7)**

**Target Watershed** refers to the primary target watershed for locating and constructing the five retrofit pilot projects. Caltrans has proposed the Carlsbad Hydrologic Unit, as defined by San Diego Regional Water Quality Control Board, as primary watershed. The Penasquitos Hydrologic Unit was considered as a first alternative or secondary watershed for locating the remaining pilot projects. If detailed site investigation of Caltrans right-of-way within the primary target watershed proved that no adequate sites for any of the five pilot projects could be found, some of the projects were located in other watersheds. A site that scores a 10 is located in the target watershed. A site in the secondary watershed scored a 5. A site located in neither watersheds received a score of 0.

**Heavy Vehicles** includes the relative number of pieces of heavy equipment, light-duty vehicles, and cars in comparison to the tributary area. For instance, a site with a score of 10 would have the highest percentage of vehicle coverage over the tributary area for the longest amount of time. A site that received a relatively low score might be a park & ride that had a low percentage of traffic relative to the available number of parking spaces.

**Asphalt Containment** refers to liquid asphalt crack sealant and solids storage containment and cover. A 10 means the containment is secure, allowing no runoff or leaching during rain events, while a lower score means the containment is poor.

**Oil/Waste Storage** refers to the storage of waste fuels. A 10 indicates good containment practices with no visual oil spills or stains in the immediate area. A lower score indicates the potential for materials to come in contact with storm water.

**Flow Path** includes on-site curb, swale, or sheet flow, which is relevant to having good sampling conditions. A 10 refers to concentrated flow and a lower value refers to shallow or a sheet flow condition.

**Site Exposure** refers to the amount of cover over the site, e.g. for 100% bridge coverage a low score would be given. No bridge cover would score a 10.

**Onsite Drainage** describes the existence of catch basins on-site. A low score means there are no catch basins within site boundaries and no opportunity to construct them as a part of the retrofit project. A 10 indicates 100% of the site runoff is captured on site where it is routed to an offsite drainage system.

**Access** refers to site accessibility for sample couriers. A low score was given for sites difficult to access by car. A 10 was scored for sites with no access restrictions.

**Traffic Safety** refers to location safety with respect to traffic. A low score means the site was dangerous, exposed to traffic hazards and a 10 means the site was safe with respect to traffic.

### **Media Filter (Chapter 8)**

**Vehicles and Heavy Equipment** includes the relative number of pieces of heavy equipment, light-duty vehicles, or cars in comparison to the tributary area. For instance, a site with a score of 10 would have the highest percentage of vehicle coverage over the tributary area for the longest amount of time. A site that scored relatively low might be a park & ride that had a small volume of usage.

**Target Watershed** refers to the primary target watershed for locating and constructing the five retrofit pilot projects. Caltrans has proposed the Carlsbad Hydrologic Unit, as defined by San Diego Regional Water Quality Control Board, as primary watershed. The Penasquitos Hydrologic Unit was considered as a first alternative or secondary watershed for locating the remaining pilot projects. If detailed site investigation of Caltrans right-of-way within the primary target watershed proved that no adequate sites for any of the five pilot projects could be found, some of the projects were located in other watersheds. A site that scores a 10 is located in the target watershed. A site in the secondary watershed scored a 5. A site located in neither watersheds received a score of 0.

**Space Available/Access** includes both the space available to construct the BMP within safety and operational constraints and the maintenance vehicle access for monitoring and maintaining the site. A site that scored a 10 would have ample space for construction, maintenance, and monitoring of the BMP including enough space to ensure that site operations and safety and not unduly compromised. A site with a low score would not have enough space to construct, maintain, or monitor the BMP.

**Proximity to Receiving Waters** refers to the distance between BMP sites and receiving waters. A score of "10" refers to drainage to a sensitive receiving water. A "0" refers to a site that has a long flow path before draining to receiving waters.

**Site Storm Drain** refers to the presence of an onsite drainage facility and receive a score of "y." Sites containing no drainage facility and allowing sheet flow to an offsite drainage facility would receive a "n."

**Drainage Pattern** includes the amount of tributary area to the inlet and the type of flow pattern (i.e. sheetflow versus well-defined concentration points). These two factors are combined so that the overall factor becomes the percentage of tributary flow that can be directed to the filter. In order for a site to score a 10, the filter would have to intercept 100% of the tributary flow to the outlet. Conversely, a relatively low score would indicate that none of the tributary flow could be directed to the filter. An ideal site might be a sump area with a filter inlet that could capture 100% of the site tributary flow.

## **Safety Setback**

For additional information, see Design Information Bulletin Number 75, "Geometric Design Criteria for Resurfacing, Restoration, and Rehabilitation (RRR) Projects."

## Topic 308 - Cross Sections for Roads Under Other Jurisdictions

### 308.1 City Streets and County Roads

The width of local roads and streets that are to be reconstructed as part of a freeway project should conform to AASHTO standards if the local road or street is a Federal-aid route. Otherwise the cross section should match the width of the city street or county road adjoining the reconstructed portion, or the cross section should satisfy the local agency's minimum standard for new construction.

Where a local facility within the State right of way crosses over or under a freeway or expressway but has no connection to the State facility, the minimum design standards for the cross section of the local facility within the State's right of way shall be those found in AASHTO. If the local agency has standards that exceed AASHTO standards, then the local agency standards shall apply.

AASHTO standards for local roads and streets are given in "A Policy on Geometric Design of Highways and Streets", AASHTO, 1990.

It is important to note that "A Policy on Geometric Design of Highways and Streets", AASHTO, 1990, standards are based on functional classification and not on a Federal-aid System.

Chapters V, VI and VII of the "A Policy on Geometric Design of Highways and Streets", AASHTO, 1990, list standards for the following six functional classes:

- o Local rural roads
- o Local urban streets
- o Rural collectors
- o Urban collectors
- o Rural arterials
- o Urban arterials

"A Policy on Geometric Design of Highways and Streets", AASHTO, 1984, gives minimum lane and shoulder widths. When selecting a cross section, the effects on capacity of commercial vehicles and grades should be considered as discussed under Topic 102 and in the "Highway Capacity Manual", 1985.

The minimum width of 2-lane overcrossing structures shall not be less than 28 feet curb to curb. Also see Index 208.1(2) and Index 307.3.

If the local agency has definite plans to widen the local street either concurrently or within 5 years following freeway construction, the reconstruction to be accomplished by the State should generally conform to the widening planned by the local agency. Stage construction should be considered where the planned widening will occur beyond the 5-year period following freeway construction or where the local agency has a master plan indicating an ultimate width greater than the existing facility. Where an under crossing is involved, the initial structure construction should provide for ultimate requirements.

Where a local facility crosses over or under a freeway or expressway and connects to the State facility (such as ramp terminal intersections), the minimum design standards for the cross section of the local facility shall be at least equal to those for a conventional highway with the exception that the outside shoulder width shall match the approach roadway, but not less than four feet (shoulder width should not be less than five feet where curbs with two-foot gutter pans are proposed and bicycle use is expected). The minimum width for two-lane overcrossings at interchanges shall be 40 feet curb-to-curb.

## Topic 309 - Clearances

### 309.1 Horizontal Clearances

(1) *General.* The horizontal clearance to all fixed roadside objects including bridge piers, abutments, retaining walls, and noise barriers should be based on engineering judgment with the objective of maximizing the distance between fixed objects and the edge of traveled way. Engineering judgment should be exercised in order to balance the achievement of horizontal clearance objectives with the prudent expenditure of available funds.

Certain yielding objects, such as sand filled barrels, metal beam guard rail, breakaway wood posts, etc. may encroach within the clear recovery zone (see Index 309.1(2)). While these objects are designed to reduce the likelihood of serious injury to vehicle occupants, collisions can be severe and efforts should be made to maximize the distance between the object and the edge of traveled way.

Clearances are measured from the edge of the traveled way to the nearest point on the obstruction (usually the bottom). Horizontal clearances greater than those cited below under

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subsection (3) - "Minimum Clearances" shall be provided where necessary to meet horizontal stopping sight distance requirements to median barriers, bridge rails, bridge columns, retaining walls, cut slopes, and noise barriers. See discussion on "... technical reductions in design speed ..." under Topic 101.

(2) *Clear Recovery Zone.* A clear recovery zone is an unobstructed, relatively flat or gently sloping area beyond the edge of the traveled way which affords the drivers of errant vehicles the opportunity to regain control.

The following clear recovery zone widths are the minimum desirable for the type of facility indicated. Consideration should be given to increasing these widths based on traffic volumes, operating speeds, terrain, and costs associated with a particular highway facility:

- o Freeways and Expressways - 30 feet
- o Conventional Highways (no curbs) - 20 feet
- o Conventional Highways (with curbs) \* - 1.5 feet

\* This clear zone is measured from the face of curb to the obstruction.

Fixed objects which are closer to the edge of traveled way than the distances listed above should be eliminated, moved, redesigned to be made yielding, or shielded in accordance with the following guidelines:

- (a) Fixed objects should be eliminated or moved outside the clear recovery zone to a location where they are unlikely to be hit.
- (b) If sign posts six inches or more in any dimension or light standards cannot be eliminated or moved outside the clear recovery zone, they should be made yielding with a breakaway feature.
- (c) If a fixed object cannot be eliminated, moved outside the clear recovery zone, or modified to be made yielding, it should be shielded by guardrail or a crash cushion.

Where compliance with the above stated clear recovery zone guidelines is impractical, the minimum horizontal clearance cited below shall apply to the unshielded fixed object.

(3) *Minimum Clearances.* The following minimum horizontal clearances shall apply to fixed objects that are closer to the edge of

traveled way than the clear recovery zone distances listed above:

(a) The minimum horizontal clearance to fixed objects such as bridge rails, safety-shaped concrete barriers, abutments, retaining walls or noise barriers on all freeway and expressway facilities, including auxiliary lanes, ramps, and collector roads shall be equal to the standard shoulder width of the highway facility as stated in Table 302.1. A minimum clearance of four feet shall be provided where the standard shoulder width is less than four feet. Approach rail connections to bridge rail may require special treatment to maintain the standard shoulder width.

(b) On two-lane highways, frontage roads, city streets and county roads (all without curbs), the minimum horizontal clearance shall be the standard shoulder width as listed in Tables 302.1 and 307.2, or as determined from Table 307.3, except that a minimum clearance of four feet shall be provided where the standard shoulder width is less than four feet.

On curbed highway sections, a minimum clearance of three feet should be provided along the curb returns of intersections and near the edges of driveways to allow for design vehicle off tracking (see Topic 404). Where sidewalks are located immediately adjacent to curbs, fixed objects should be located beyond the back of sidewalk to provide an unobstructed area for pedestrians.

A safety shaped barrier face should be constructed integrally at the base of any retaining, pier, or abutment wall which faces traffic and is 15 feet or less from the edge of traveled way (right or left of traffic and measured from the face of wall). See Index 1102.4 for the treatment of noise barriers.

The minimum width of roadway openings between temporary K-rail on bridge deck widening projects should be obtained from the District Permits Engineer.

See Chapter 7 of the Traffic Manual for other requirements pertaining to clear recovery zone, guardrail at fixed objects and embankments, and crash cushions.

# **Structural Setback**

## **MEMORANDUM**

**To:** Scott Taylor, MS 140 JN 34122  
**From:** Paul Young, Vice President, Structural Engineering  
**Date:** January 27, 1998  
**Subject:** Storm Water Quality BMP - Infiltration Basin or Trench Siting

---

This memorandum addresses the potential impact of infiltration basins and trenches being located in the vicinity of bridge foundations as part of the implementation of the Pilot Retrofit Best Management Practices program.

storm water run-off collected in the vicinity of the bridge would be collected and discharged to either an infiltration basin or trench. trenches would have approximate dimensions of 5 feet wide, 5 to 7 feet deep and a length possibly up to 100 feet, basins would be up to about 5 feet deep and cover an area sufficient to store the computed storm water infiltration volume. Final dimensions would be sized to accommodate the expected runoff. The percolation trench would be filled with sand and gravel. The purpose of each system is to allow storm water to percolate into the ground at the location it is collected, rather than discharge the water to a storm drain system.

The concern with respect to the bridges which would be in the vicinity is whether the percolation into the ground would impact the bridge foundation capacity and at what distance could the basin or trench be situated from the foundation such that no impact from the percolation would be expected at the bridge foundation.

First, it is reasonable to assume that discharging run-off immediately adjacent to the bridge foundation could impact the soil and foundation capacity, especially in the case of spread footings. It is therefore prudent to locate the percolation basin or trench some reasonable distance from the foundation.

As water percolates through the sides and bottom of the basin or trench the general tendency would be for the water to percolate downwards due to gravity as it also migrates laterally, especially if the natural ground water level is not near the surface. For this case (with somewhat deep ground water level) it would seem reasonable that the groundwater would not migrate at shallower than a 1 horizontal to 1 vertical slope. It would be unusual

for the piles of a bent footing supported on piles to extend deeper than about 70 feet below the existing grade. Therefore, allowing for some additional factor of safety, a lateral distance of 100 feet from the foundation to any point along the infiltration trench or basin should sufficiently avoid any impact to the bridge foundation.

For the case where the natural ground water table is near the surface and percolation may be somewhat lateral, rather than downward, it is likely the presence of ground water has already been considered in the design of the bridge foundation.

Based upon this empirical reasoning a distance of 100 feet between the bridge edge of footing and the percolation basin or trench should avoid any detrimental impact to the bridge foundations. The placement of an infiltration BMP closer than 100 feet would require a more detailed geotechnical and bridge structural evaluation.

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## **District 11**

# **Infiltration Trench Calculations**



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JOB 34122

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## Preliminary Infiltration Trench Design Calculations.

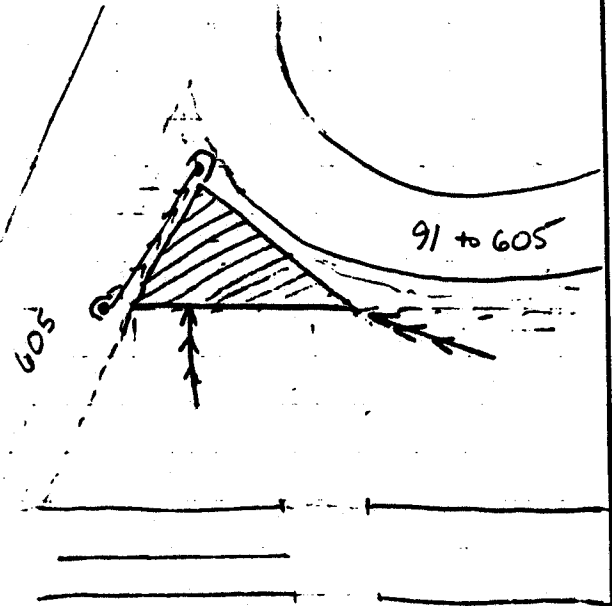
Reference: "Caltrans Storm Water Quality Handbooks"

SITE ①: CERRITOS MS : A  $\approx \frac{3}{4}$  acre

Approx Surface Area:  $\frac{1}{2}$  bli  
 $\frac{1}{2} (60 \times 40) = \underline{1200 \text{ ft}^2}$

Depth	Volume Max. Hold
2	.840 ft <sup>3</sup>
3	1260
4	1680
5	2100
6	2520
7	2940
8	3360
9	3780
10	4200

NOTE: Assuming aggregate has a 35% void space.



From the Caltrans Storm Water Quality Handbook, PD11B(1):  
 Storm Volume computation chart:

Zone: Los Angeles

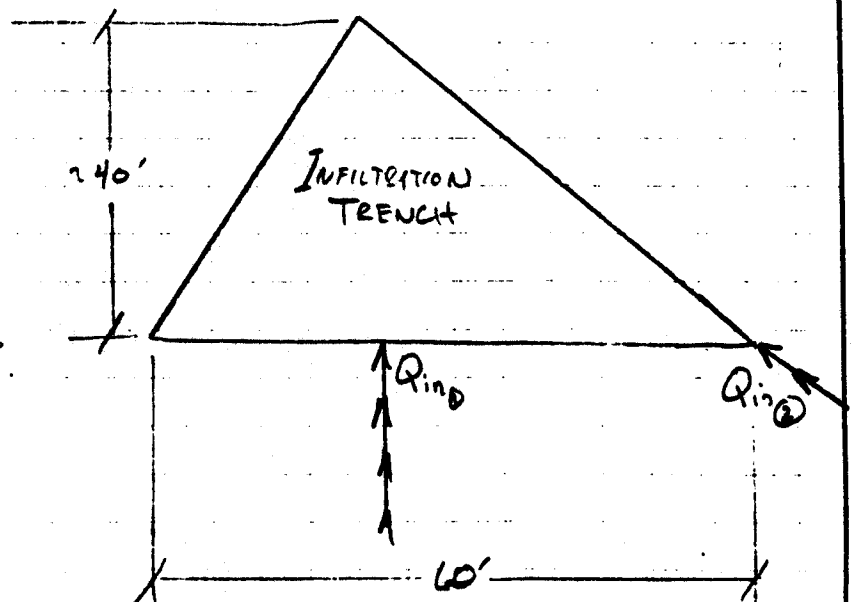
Using 80%-100% Impervious Area.

$$Q_{(1\text{yr} \cdot 24\text{hr})} \approx 180 \text{ m}^3/\text{ha} \Rightarrow 2574 \frac{\text{ft}^3}{\text{acre}}$$

$$V = QA_{\text{area}} = 1930 \text{ ft}^3$$

Approximation of expected runoff.

∴ depth  $\approx 4\frac{1}{2}'$





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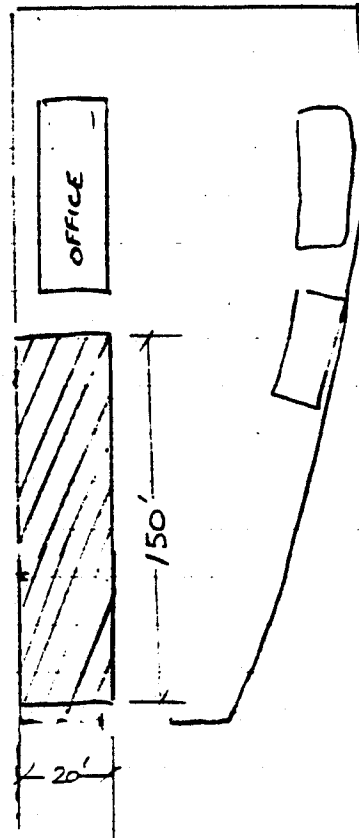
SITE ②: TARZANA MS : Tributary  $\approx 3\frac{1}{2}$  acres

Approx. SURFACE AREA:

$$(150)(20) = \underline{3000} \text{ ft}^2$$

Depth	Volume Max. H <sub>2</sub> O
2	2,100
3	3,150
4	4,200
5	5,250
6	6,300
7	7,350
8	8,400
9	9,450
10	10,500

NOTE: Assuming aggregate has a 35% void space.



$$Q_{(1\text{yr}-24\text{hr})} \approx 180 \text{ m}^3/\text{ha} \approx 2574 \text{ ft}^3/\text{acre}$$

$$V = QA = 9000 \text{ ft}^3$$

$$\therefore \text{depth} \approx 8\frac{1}{2}'$$

$$V = 180 \text{ m}^3/\text{ha} \quad 8200$$

\* NOTE: The dimensions used in these calculations for trench sizes are only rough approximations.



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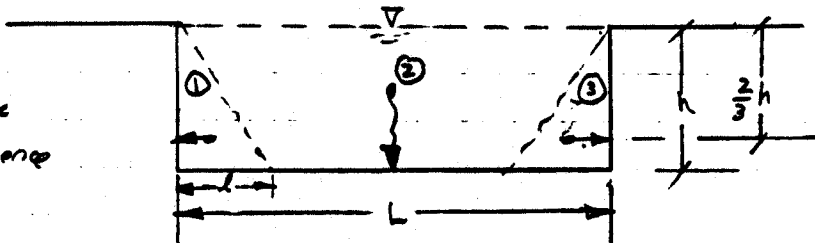
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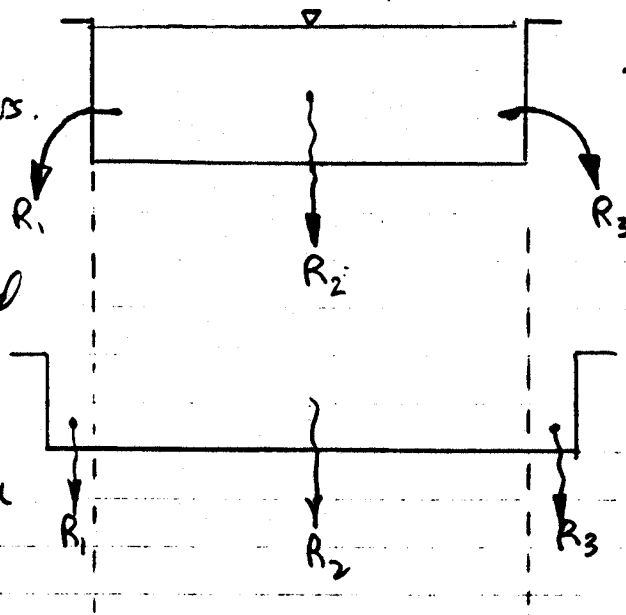
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Cerritos MS  
Trench.

Looking @ hydrostatic pressures that influence exfiltration.



Since the hydrostatic pressure decreases as the water level lowers, the rate of exfiltration also lowers.



-fig 2.

Resultant hydrostatic forces.

To estimate an average Hydr. Pressure, the midpoint or  $(\frac{h}{2})$  level was considered for calcs on all R values.

-fig 3.

Equivalent hydr. forces.

Since the side exfiltration is near vertical, it was approximated by the following:

$$Q_{\text{tot}} = IA \quad \text{where } Q = \text{capacity of basin discharge / day}$$

$$I = \text{Vertical Infiltration rate } (2.5 \times 10^{-6} \text{ ft/sec})$$

$$A = \text{Area of basin}$$

$$P = \text{ft}$$

$$Q_{\text{tot}} = Q_1 + Q_2 + Q_3$$

$$Q_{\text{tot}} = I(A_1 + A_2 + A_3)$$

$$A_2 \Rightarrow (\text{Floor area}) = 1200 \text{ ft}^2$$

$$A_1 = A_3 \Rightarrow (\text{effective side areas}) \text{ triangular P side water}$$

$$\Rightarrow (\text{height})(\text{perimeter}) = (\frac{4.2}{2})(190') = 430 \text{ ft}^2$$

cog.  
@ side wall

$$Q_{\text{tot}} = I(1200 + 430)$$



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$$\therefore t = \frac{V_{ok}}{Q_{tot}} = \frac{1930 \text{ ft}^3}{(2.5 \times 10^{-7} \text{ ft/sec})(1630 \text{ ft}^2)}$$

$$t \hat{=} 5.48 \text{ days} \quad \sim 5\frac{1}{2} \text{ days.}$$

TARZANA MS  
Trench #1

$$Q_{TOT} = IA$$

$$(I = 1.1 \times 10^{-7} \text{ ft/sec.})$$

$$Q_{TOT} = I(A_{BOT} + A_{SIDE})$$

$$A_{BOTTOM} = 3000 \text{ ft}^2$$

$$A_{SIDE} = \frac{1}{2}(\text{height})(\text{perimeter}) \Rightarrow \frac{1}{2}(8\frac{1}{2})(340') = 1445 \text{ ft}^2$$

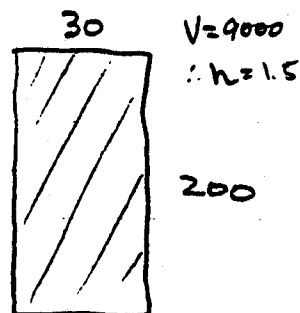
$$Q_{TOT} = (1.1 \times 10^{-7} \frac{\text{ft}}{\text{sec}})(3000 + 1445)$$

$$Q_{TOT} = 4.8895 \times 10^{-4} \frac{\text{ft}^3}{\text{sec}}$$

$$t = \frac{V_{ok}}{Q_{TOT}} = \left( \frac{9000 \text{ ft}^3}{4.8895 \times 10^{-4} \frac{\text{ft}^3}{\text{sec}}} \right) \hat{=} 213 \text{ days} = t$$

TARZANA MS  
Trench #2

$$\text{Trench: } L = 200', w = 30'$$



$$\therefore Q_{TOT} = I(A_s + A_b) = I(6000 + \frac{1}{2}(1\frac{1}{2} \cdot 400)) = 6.7518 \times 10^{-4}$$

$$t = \frac{V_{ok}}{Q_{TOT}} = \left( \frac{9000}{6.7518 \times 10^{-4}} \right) = 154 \text{ days} = t$$

**Caltrans Proposal for  
San Diego Retrofit Projects,  
October 23, 1997**

## Retrofit Pilot Program, Caltrans District 11

### Background

Caltrans will undertake five retrofit pilot projects in District 11, comprised of eight types of Best Management Practices (BMPs). Caltrans will develop and implement a coordinated pilot program to test the feasibility and effectiveness of designing, constructing and maintaining the selected BMPs. The program will be implemented in a single watershed in District 11 and integrated with existing Caltrans facilities; however, some projects may be located outside of the selected 'target' watershed if a suitable number of sites cannot be located within the target watershed area. The five proposed retrofit projects and estimated construction costs are described in Table 1.

**Table 1**

Project	Description	# Sites	Construction Cost
1	Biofilter* and Infiltration Basin	2	\$882,344
2	Biofilter* and Infiltration Trench	2	\$281,516
3	Extended Detention/Infiltration Basins	2	\$634,608
4	Wet Basin	1	\$352,196
5	Oil/Water Separator/Media Filter	3	\$368,551
Construction Total – All Projects			\$2,519,215

\*One site will be constructed using a biofilter swale; the second site will be constructed using a biofilter strip.

### General Project Criteria

For each project defined above, Caltrans will design, construct, maintain and monitor the BMP system. The objectives of the program will be as follows:

1. Determine the feasibility of design, construction and maintenance of the selected BMPs;
2. Evaluate the performance of the selected BMPs in removing constituents of concern in highway stormwater runoff;
3. Evaluate the frequency and magnitude of operational problems associated with maintenance of the structures and maintenance and safety concerns specific to transportation facilities.

Complete records of design, construction, operation, maintenance and monitoring will be kept as a part of the pilot study program for use in the development of a final report as to the feasibility, performance and operational characteristics of the defined projects.

## **Project Descriptions**

### **Project 1 – Biofilter and Infiltration Basin**

Project 1 consists of identifying 2 sites along a Caltrans freeway or highway to construct combination biofiltration swales/strips and downstream infiltration basins. The biofilter/basin combinations will be constructed at locations where sheet flow occurs from highway pavement, and where a downstream infiltration basin may be constructed. Runoff from the biofilter may be piped to the infiltration basin location if sufficient right-of-way is not available adjacent to the edge of pavement for construction of the infiltration basin in close proximity. One site will be constructed using a biofilter swale upstream of an infiltration basin. The second site will be constructed using a biofilter strip upstream of an infiltration basin. The infiltration basins will be constructed to intercept and infiltrate the selected design storm. The vegetated swale/strip will be constructed upstream from the basin to remove particulates that could potentially clog the infiltration basin. The biofilter/basin combinations will be visually monitored over a two year period using the following criteria:

- Maintenance frequency of the basin to maintain adequate infiltration rate;
- Rate of infiltration under the typical storm condition;
- Problems associated with disposal of material that accumulates in the basin;
- Potential for groundwater contamination and associated regulatory implications.

The project will establish procedures and schedules for maintenance of the swales, strips and basins. Influent and effluent to the biofilter shall also be monitored for water quality parameters using automatic samplers. Groundwater will be sampled using a well, or pressure-vacuum lysimeter in the case where the groundwater table is relatively deep. Rate of percolation to the basin will be monitored, and testing of the basin sediments will be performed at the end of the established monitoring period. The construction cost for each component of Project 1 is estimated to be \$426,804 for the swale/basin location and \$455,540 for the vegetated strip/basin combination for a total construction cost for Project 1 of \$882,344.

### **Project 2 – Biofilter and Infiltration Trench**

Project 2 is similar to Project 1 except an infiltration trench is substituted for the infiltration basin. Project 2 may be more practically implemented in areas where right-of-way is limited and the tributary area is smaller. Design and monitoring criteria will be as indicated above except that sediments will not be monitored. Infiltration trenches will be equipped with monitoring wells to allow computation of infiltration rates, and observations relative to declining infiltration performance.

Biofilter/infiltration trenches will be constructed at two sites at Caltrans maintenance facilities, park and ride lots and/or District office parking areas. One site will be

constructed with a vegetated swale and infiltration trench combination, the second site will be constructed with a vegetated strip/infiltration trench combination. The construction cost for each component of Project 2 is estimated to be \$126,390 for the swale/trench location and \$155,126 for the vegetated strip/trench combination for a total construction cost for Project 2 of \$281,516.

### **Project 3 – Basin Investigation – Extended Detention and Infiltration**

Two basins will be constructed at locations along an existing freeway or highway serving a Caltrans storm drain outfall. The project will consist of constructing one extended detention basin, and one infiltration basin to determine the feasibility of constructing these types of BMPs within the highway right-of-way, and to assess their performance relative to the removal of highway constituents of concern. The extended detention basin will be designed with a detention time of 48 hours for the selected design storm. The infiltration basin will be designed to capture and infiltrate the selected design storm. Larger storm events will exceed the capacity of the basins and discharge through the facility overflow weir. Water quality will be sampled using automated equipment for the extended detention basin inflow and outflow to determine basin efficiency in the removal of highway stormwater runoff constituents. Sampling for the infiltration basin will be as described for Project 1.

The construction cost for each component of Project 3 is estimated to be \$282,412 for the extended detention basin and \$352,196 for the infiltration basin, for a total Project 3 construction cost of \$634,608.

### **Project 4 – Wet Pond**

Project 4 will consist of the construction of a wet pond serving a Caltrans freeway or highway. The pool volume shall be equal to the runoff volume from the design storm, and additional volume will be provided above the permanent pool to provide a 24 hour drain time for the design storm event. Emergent vegetation will be planted around the pond periphery to enhance constituent removal and improve aesthetics. A perennial water source will be a key component of the siting of this BMP. Possible water sources include locations where there is groundwater infiltration to the Caltrans storm drain system, or where the pond may be excavated to intersect the groundwater table. It will be important to sample this 'source' water to document the constituents it contains. It is anticipated that such baseline sampling can be completed early in the evaluation process.

Monitoring of the pond stormwater influent and effluent will be accomplished using automatic samplers, flowrate will also be monitored and pond sediments will be sampled at the termination of the monitoring period.

The construction cost for the wet pond is estimated to be \$352,200.

## **Project 5 – Oil/Water Separators and Media Filters**

Project 5 consists of identifying 1 site for the installation of an oil/water separator and 2 sites for the installation of media filters. The separators will be constructed at Caltrans maintenance facilities or truck scales/immigration check points where vehicles are parked for long periods of time. The separators shall be the coalescing-plate (CPI) type and installed in locations where gravity flow may be used. The separator shall have a forebay to collect floatables and the larger settleable solids, and shall also have an afterbay in which oil-absorbent pillows or similar material may be placed.

The separators shall be monitored to ensure they are clean and operating properly, with the oil absorbent pads replaced prior to each season. Influent and effluent will be monitored using 'grab' sampling. Samples will be monitored for total oil and grease.

Two sites will also be selected for the installation of sand or compost filters. The filters will be constructed at maintenance stations, park and ride lots, or immigration/border check points and/or truck scale facilities where large vehicles are parked for continuous periods. The media filters will be designed using established procedures and manufacturers recommendations. Water quality monitoring will be performed following construction to determine the performance of the filter in removing constituents in highway runoff. Inflow and outflow will be monitored using automatic sampling equipment. The filters will also be monitored relative to maintenance requirements, with specific attention given to the frequency of maintenance required to maintain the effectiveness of the filter.

The total construction cost for the oil/water separator is estimated to be \$71,565, and the total construction cost for the media filters is estimated to be \$296,986, for a total construction cost of Project 5 of \$368,551.

### **Project Outline**

The general steps in the implementation of the District 11 retrofit project will be as shown in the following project outline:

#### **1. Project Site Selection**

- A. Preliminary Site Selection
  - 1. Identify Candidate Sites
  - 2. Refine to Preliminary Sites
  - 3. Develop Preliminary Site Reports
  - 4. CT/EPA/NRDC Review/Field Review
- B. Final Site Selection

#### **2. Project Design**

- A. Site Survey
- B. Site Topography Compilation

- C. Plan Preparation
- D. Plan Check
- E. Plan Revisions
- F. Plans Signed/Released for Construction
- 3. Bid Projects**
  - A. Advertise
  - B. Award
  - C. Construction Begins
- 4. Construction**
  - A. Project 1
  - B. Project 2
  - C. Project 3
  - D. Project 4
  - E. Project 5
- 5. Monitoring**
  - A. Visual Monitoring
  - B. Stormwater Quality Monitoring
- 6. Report**
  - A. Write Final Report
  - B. Review by CT/EPA/NRDC
  - C. Revisions
  - D. Final Report

**Water Quantity**  
**Mitigation Paper**

## Background

San Diego Consent Decree requires Caltrans to implement Retrofit Pilot Program in District 11. The Retrofit Pilot Program is designed to determine the appropriateness of retrofitting at Caltrans' existing facilities and rights-of-way. One of the criteria used to determine appropriateness is "potential for improvements in water quality, including without limitation water quantity effects". This paper examines the issue of "water quantity effects".

## Issue

A stream is defined as 'stable' if it is in equilibrium with the flow it carries and with the characteristics of the bed and bank material. The term 'dynamic equilibrium' is often used to characterize geomorphic equilibrium which Lane (1955) developed as:

$$Q_s, D_{50} \propto Q, S$$

where  $Q_s$  is the sediment discharge  
 $D_{50}$  is the median sediment size  
 $Q$  is the water discharge  
 $S$  is the channel slope

The above relation states that flow moves sediment downstream at a rate proportional to the slope and discharge of the stream. Urbanization can impact both  $Q_s$  and  $Q$ , in turn impacting the channel slope. For example, given an increase in discharge commonly associated with urbanization, and assuming that the supply of sediment remains constant, the channel slope will flatten through a degradation process. Conversely, when flow decreases the slope of the waterway will increase, reflecting the aggradation process.

As pointed out by Urbonas and Benik (1995), general degradation of urban waterways occurs as a result of urbanization, resulting in changes to the stream cross section and the transport of sediment to downstream receiving waters. Further, it is the annual (bankfull) and smaller storms that shape the waterway and dominate the shape of the stream.

Leopold (1994) has studied the principal of bankfull discharge in detail. The bankfull discharge is considered to be the discharge that dominates the channel cross section and slope. The bankfull discharge is the flow that has a recurrence interval of about 1.5 years. Leopold did extensive study of a small stream in Maryland over the span of 20 years. He noted that the number of times that the channel exceeded bankfull increased dramatically as urbanization occurred in the watershed with associated changes in the channel cross section.

Urbanization changes not only the water discharge in a stream, but the sediment discharge as well. Suspended load can be reduced as a result of the construction of impervious surfaces. The primary source of suspended load in most locations is from sheet erosion. In the absence of this mechanism, bank erosion may become more pronounced. Consequently, the impact to a given stream course from urbanization is not easily assessed through an examination of peak flow rates only, although it is clear that the dominate (1.5-year) discharge plays an important role in such an analysis. Rather, a comprehensive assessment would include an examination of sediment load to a particular reach as well as review of hydrologic parameters.

### **Stormwater Management**

Storm water management is based on the premise of replacing natural retention that is lost as a result of urbanization (depression storage, infiltration) with constructed detention storage. However, unlike natural retention, constructed detention volume is only temporarily stored. While this system may reduce downstream flooding, timing of the various detention structures in the watershed becomes of critical importance. Dendrou and Delleur (1982) note that various investigators have examined this problem and conclude that the planning of stormwater control must be done on a watershed basis as opposed to a sub-area or piecemeal approach. Others also note that unplanned placement of multiple detention reservoirs may aggravate flood hazards (Lumb, et.al, 1974) (Abt and Grigg, 1978). Further, McCuen (1978) arrived at a similar conclusion based on a watershed study in Montgomery County, Maryland where a stormwater management scheme increased both peak flow and the bedload transport rates and the duration of bankfull flow in the channel downstream of the facility.

The problem with onsite detention lies in the fact that flow from the subject site may be retained until the peak flow a larger upstream area arrives, resulting in increased discharges. Alternatively, on-site detention may simply have little or no net benefit in reducing peak flow in the receiving stream. Consequently, on-site detention is indicated in cases where the flows in the receiving stream will be significantly impacted through development of the site. This would generally exclude cases where the site discharges directly to a municipal storm drain system sized to convey the site flow. Where the municipal storm drain system discharges to the regional channel there may still be an opportunity for detention depending on the relative size of the sub-watershed to the receiving stream watershed and location within the receiving stream watershed.

Another issue that must be kept in mind is the common practice of single-recurrence-interval design. Detention facilities that are designed to mitigate the peak 25-year discharge will have little, if any benefit for storms with more frequent recurrence intervals, which have previously been shown to be the events transporting the largest volume of sediment and responsible for channel cross section shape and alignment.

## Review of San Diego BMP Retrofit Sites

As discussed above, the benefits of on-site detention may be achieved for small watersheds that will undergo significant change in discharge as a result of development. The sites at Manchester Avenue (east and west), La Costa Boulevard and at the I-5/SR 78 park and ride and at the I-5/SR 56 interchange each discharge directly to a storm drain system that subsequently discharges directly to a lagoon. Peak flow mitigation would be without benefit in these cases.

The sites at SR 78/I-15, Escondido Maintenance Station, Melrose at SR 78, Palomar Airport Road, Kearny Mesa Maintenance Station and the Carlsbad Maintenance Station all discharge through municipal systems to receiving streams with comparatively large watershed areas. On-site detention in these instances would reduce the peak discharge from the site, but would maintain the reduced discharge for a longer period, thus potentially increasing the peak flow in the receiving stream. This is due to the fact that the watershed lag time for the site is substantially shorter than the watershed lag time for the receiving stream. The watershed lag time is defined as the time from the center of mass of the effective rainfall to the center of mass of the discharge hydrograph. The lack of benefit from on-site detention will be demonstrated through a case study.

### Case Study – SR 78 at Melrose Avenue

The Pilot Program site at Melrose place on SR 78 is selected as representative of the cases listed above. The site area is 2.3 acres and discharges directly to Buena Vista Creek. Buena Vista Creek has a watershed of about 5825 acres at the confluence point with the discharge from the Pilot site. Discharge hydrographs were computed for the 2-year storm for both the Pilot Program Site and the Creek watershed, the results of this analysis, along with some of the hydrologic parameters used, are given in Table 1.

Table 1

Watershed	Area (ac.)	Lag Time (hrs)	CN	Q <sub>2</sub> (cfs)
Buena Vista	5825	0.6	68	186.97
Pilot Site	10	0.16	84	2.0

Note that the watershed area used for the Pilot site is 10 acres, which is the minimum allowed by the computer program for the hydrograph procedure. For the purpose of this analysis, such an approximation will not be significant. As shown in Table 1, the lag time for Buena Vista Creek is much larger than that for the pilot site. The lag time for Buena Vista Creek was calculated using the Corps of Engineers Lag formula, the lag time for the Pilot site was estimated as 10 minutes following Caltrans procedure for inlet times on freeways. The Corps formula for watershed lag is:

$$Lag(hrs) = 24n \left( \frac{L(L_{ca})}{\sqrt{S}} \right)^m$$

where:

- n = Basin factor
- m = Constant (0.38)
- L = Length along the longest watercourse, in miles
- L<sub>ca</sub> = Length along the longest watercourse, in miles, measured upstream to a point opposite the center of area.
- S = Watershed slope

The Curve Number (CN) for the Buena Vista site was estimated using land use information from the USGS Quad and adjusted for Antecedent Moisture Condition (AMC) I consistent with a 2-year analysis. The CN for the Pilot site was estimated to be 94 (AMC II) assuming an impervious fraction of 80 percent for the roadway and shoulder area and subsequently adjusted to AMC I.

The Pilot Site hydrograph was subsequently routed through a hypothetical on-site detention structure which reduced the peak flow by one-half to 1 cfs, a flow that could be considered consistent with the natural condition from the site. Combining the routed flow from the site with the hydrograph from Buena Vista Creek, and keeping reference to an established time base, the peak discharge downstream of the site with the on-site detention was determined to be 187.23 cfs. This 'mitigated' flow rate is 0.2 cfs higher than the non-mitigated flow rate due to the effect of delaying the discharge from the pilot project site at a higher level than would otherwise occur under a no-detention scenario. The detention results in the case where no net benefit occurs to the receiving stream. It is clear that a more regional solution is imperative to achieve a net beneficial impact in the receiving stream. Detailed hydrograph calculations are contained in the Appendix for reference. However, this appendix was omitted in the Composite Siting Study.

This example may be generalized for the remaining Pilot Project sites which discharge to the streams. At each site, the lag time is substantially less than the receiving water lag time, making on-site detention ineffective. Such a conclusion is expected where a relatively small site is located well downstream of the larger watershed's headwaters. In general, on site detention would be beneficial only for those sites where the project site is closer in size and computed lag time to the receiving stream watershed.

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